The Engineer

LONDON, FRIDAY, OCTOBER 17, 1941

PUBLIC NOTICES

HULL EDUCATION COMMITTEE

MUNICIPAL TECHNICAL COLLEGE

Applications are Invited for the POSITION of LECTURER in CHARGE of the MARINE ENGINEERING SCHOOL to commence duties on the 1st January, 1942. Candidates should preferably hold the Extra First Class Board of Trade Ticket and have had some experience in teaching and coaching work. Salary £300 per annum, rising to £365, with additional pay for evening classes.

Particulars and application forms, which should be returned not later than Monday, the 3rd November, may be obtained from R. C. MOORE, Director of Education, Guildhall, Hull, on receipt of stamped addressed foolscap envelope. 7847

THE INSTITUTION OF CHEMICAL ENGINEERS

EXAMINATION, 1942

Application Forms (Returnable 15th December, 1941) and particulars of the ASSOCIATE MEMBERSHIP EXAMINATION for 1942, together with the MEMORANDUM on "The Training of a Chemical Engineer," may be obtained from the HON. REGISTRAR, Institution of Chemical Engineers, 56, Victoria Street, Westminster, London, S.W.1. 7848

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TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

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IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS 1940 No. 877

RESTRICTION ON ENGAGEMENT ORDER

ASSISTANT CIVIL ENGINEER.—APPLICATIONS are INVITED for a TEMPORARY APPOINTMENT with the Colne Valley Water Company. Candidates should have had experience in Water Supply and General Structural work, and be corporate members of the Institution of Civil Engineers or have equivalent qualifications.—Further particulars and forms of application may be obtained from E. CASPALL GREEN, Chief Engineer, Colne Valley Water Co., Aldenham Road, Watford, Herts. 7844 A

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The Engineer

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The Engineer

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This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER each alternate month. Next date, October 31st.

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Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

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A 41/18

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A Seven-Day Journal

The British Engineers' Association

AT a meeting of the Council of the British Engineers' Association following the twenty-ninth annual ordinary general meeting held on October 9th, 1941, at the Connaught Rooms, London, W.C.2, Mr. Joseph James Carter, the managing director of Crossley Bros., Ltd., of Openshaw, Manchester, and chairman of Crossley-Premier Engines, Ltd., of Sandiacre, near Nottingham, was unanimously re-elected President of the Association for the third successive year of office. By a resolution of the Council, Mr. Cecil Bentham, the chairman and managing director of Henry Simon, Ltd., of Cheadle Heath, Stockport, and a member of the boards of several other important engineering companies, was unanimously elected a Vice-President of the Association. The following Vice-Presidents were also re-elected :—Mr. A. Vines, M.A., of Evershed and Vignoles, Ltd., London ; Mr. E. Bruce Ball, of Glenfield and Kennedy, Ltd., Kilmarnock ; Mr. J. Maughfling, of John I. Thornycroft and Co., Ltd., of London ; and Major C. P. Napier Raikes, M.C., of the British Oxygen Company, Ltd. At the annual general meeting the members of the Association, acting on the recommendation of the President's Advisory Committee and following the wartime precedent set last year, unanimously re-elected the present Council *en bloc*.

Control of Rates of Hire of Plant Order

THE Ministry of Works and Buildings wishes attention to be drawn to the recently published Order on Control of Rates of Hire of Plant, Statutory Rule and Order, 1941, No. 1277, which is now obtainable from the Stationery Office. The Order sets out a list of maximum rates at which various types of building and civil engineering contractors' plant can be let out for hire, and the conditions governing such hire. It is pointed out by the Ministry that these rates apply not only to plant hired out on Government work, but also to plant hired out on private work, and that while the Order is in force, it is illegal to exceed these rates in any circumstances. The Order further provides that every person carrying on, or employed in connection with, any undertaking whose business or part of whose business is, or involves, the letting or taking on hire of any item of plant or other item mentioned in the schedule of hire rates accompanying the Order, shall at all times during normal business hours admit to any premises under his control where any such business of letting or taking on hire is carried on, or such item of plant or other item situate, or where any books, accounts, or other documents relating to any such business are situate or kept, any person authorised by the Ministry of Works and Buildings to enter and inspect such premises, and shall, if requested to do so by any person so authorised, produce to such person or to a person of such class or description as may be mentioned in the request, such books, accounts, or other documents relating to the undertaking, or furnish him with such estimates, returns, or information relating to the undertaking as may be mentioned or described in the request. The Order came into force on August 22nd, 1941.

Employment Returns

THE employment returns which were officially issued by the Ministry of Labour and National Service on Friday, October 10th, show that the number of men and boys registered at Employment Exchanges in Great Britain as wholly unemployed at September 15th was 100,048, a decrease of 16,079 as compared with August 11th. Of this total, 30,462 had been classified by interviewing panels as unsuitable for ordinary industrial employment. Those registered as on short time or otherwise temporarily suspended from work on the understanding that they were shortly to return to their former employment numbered 7924 ; this was a decrease of 7642 as compared with August 11th. Those registered as unemployed casual workers (being persons who normally seek their livelihood by jobs of short duration) numbered 9511, a decrease of 2471 as compared with August 11th. The corresponding figures for women and girls at September 15th were 96,546 wholly unemployed (of whom 3477 had been classified by interviewing panels as unsuitable for normal full-time employment and 3088 had been classified as unable for good cause to transfer to another area, although employment was not likely to be available locally), 16,049 temporarily stopped and 543 unemployed casual workers. As compared with August 11th the numbers wholly unemployed showed a decrease of 7098, those temporarily stopped a decrease of 6335, and unemployed casual workers a decrease of 43. A table which accompanies the returns shows the difference between August 11th, 1941, and September 15th, 1941, in the total numbers unemployed on the registers in the various administrative regions, and indicates a welcome reduction of unemployed in all the centres.

Royal Engineers Trade Training Exhibition

ON Monday, October 13th, an interesting Trade Training Exhibition was opened at the School of Military Engineering, Brompton Barracks, Chatham. It is designed to demonstrate the necessity of sound knowledge and versatility in tradesmen of the Royal Engineers, and how the training is carried out in the School, with the object of raising trade skill from Class III to Class II. An inspection of the different workshops showed clearly the great variety of jobs R.E. tradesmen may be called upon to perform, which range through all the trades to be found in the engineering and building industries. It was particularly noted that the sappers have many more jobs than field-works and bridging. Men, it was pointed out, frequently are called upon to work under various conditions, often independently and away from supervision. A high standard is called for, and it was noted that an Army trade often combines two or more civilian trades, making for an all-round training. The instruction given in the School is modelled on general lines, and there is no particular use made of special Army equipment, but productive work is done wherever possible. The technique of instruction was clearly explained by a special stand of exhibits, while near to that stand was one on which were displayed some excellent exhibits taken from an Arts and Craft Exhibition which was recently held in the unit. In a tour through the various workshops, groups of visitors were shown the men at work on different branches of engineering trade instruction. The students, we were given to understand, are drawn from the various Royal Engineer units, which are now stationed all over Great Britain and Northern Ireland, together with a good percentage of Royal Canadian Engineers. In the majority of cases the men under training were serving war engagements only.

Federation of British Industries

ON Wednesday, October 8th, the Federation of British Industries, at the meeting of the Grand Council, marked the occasion of the Federation's twenty-fifth anniversary by sending a message to Mr. Winston Churchill, the Prime Minister. That message expressed to Mr. Churchill the Federation's sincere and heartfelt admiration for his leadership and courage during these stern months, and assured him of the determination of British industry under his inspired leadership to carry out its part in the double task of equipping the Fighting Forces with the instruments of war, and maintaining in health and all possible safety the normal life of the nation. In conveying to the Grand Council his warmest congratulations upon the twenty-fifth anniversary of the foundation of the Federation and upon its many achievements in the industrial field since it was first set up, Mr. Churchill expressed the gratitude of the Government to all sections of industry for the magnificent contribution they were making to the war effort. The Government, he said, valued the Council of the Federation and welcomed its advice and assistance. If we all pursued our course in the spirit of co-operation which animated the Federation's message, then we could, Mr. Churchill said, march forward with good confidence. In his speech made at the Council meeting Lord Dudley Gordon, the President of the Federation, referred to the co-operation of the Federation with the British Employers' Confederation on all labour questions. Progress, he said, was being made with the capacity clearing centres set up under the Regional Boards to which the F.B.I. attached much importance. He dealt with the problems of export, partnership in planning, and the post-war problems. We could, Lord Dudley Gordon concluded, gain encouragement for the future from our experience of the past. The F.B.I. had been organised in a manner that enabled it to stand the test of two wars. A greater task, he suggested, when peace came would be the need for all the strength of organised industry to repair the damage now being caused in the world. Those problems would not be insoluble if all men of goodwill continued to work together in a common effort of restoration. To-day, however, Lord Dudley Gordon concluded, we had but one clear task before us—to focus all our energies on winning the war.

The Future of British Railways

SPEAKING in the House of Lords on Tuesday, October 14th, Lord Monkswell inquired whether the technical and administrative development of British railways was included in the Government's planning for the post-war period. He said that now the Government had taken over responsibility for railway finance it had become directly interested in railway efficiency. In railway history the last eighty years, largely wasted, had been responsible for the difficulties in which the railways now found themselves. Lord Balfour of Burleigh referred to the pioneer work of railway engineers and financiers, and contended that the railway managements had done everything in their power to improve efficiency. During the period 1928 to 1938 the railways in this country had spent no less than £260,000,000 on improvements of all kinds. That, he said, was a striking proof of efficiency. The size of British railways was already very great. The staff totalled over 550,000 persons and the wage bill was £123,000,000. At present a very high degree of efficiency had been achieved. In reply, Lord Leathers, the Minister of War Transport, said that the question of the post-war planning of railways had the intense interest and consideration of the Government. The railways could not be considered alone in this connection ; they were interlinked with road and other forms of transport. Inland transport was a most important matter of post-war reconstruction. The railway companies and workers had achieved the most creditable results during the war, and there was good reason to think that, in spite of adverse conditions, they would contribute still more in a total effort to deliver the goods. While the immediate task of war occupied our first attention, much thought was being given to the problem of post-war reconstruction and the progress of the railways. The Ministry of War Transport was in touch on the matter with the Minister without Portfolio, who had general responsibility for post-war planning.

Links in the History of the Locomotive

By E. A. FORWARD

No. II

(*Continued from page 233, October 10th*)

CERTAIN writers have stated that each of the early Stockton and Darlington engines had its own special driver, who, when his engine was laid up, either assisted in its repair or did some other work. Actual evidence, however, does not seem to support these statements, as we find from Hackworth's notebook that drivers did change their engines. Moreover, in one list of engines, published by J. W. Hackworth, no less than three engines are put down to one driver.

If, as stated in the Prussians' report, it was, in 1827, intended to work the traffic with five engines, with one in reserve to take the place of one under repair, then only five drivers would have been necessary, and when an engine was laid off for repair its driver would work the spare one. This seems to have been the case in September, 1827, when Hackworth recorded the relative work done by horses and locomotives. He gave the names of five drivers at a time when there were only the five Stephenson engines at work and Wilson's engine was being converted into the "Royal George."

Hackworth's notebook contains several interesting references to the earliest engines during the year covered by it. For instance, on November 17th, 1827, he records that James Stephenson broke a crank at Darlington, and was engaged next day repairing it.

In October, 1827, "T.H. gave workmen at New Shildon 3/– when Cree's engine fell over"; while on October 25th he "Paid 2/– to Thos. Clark for taking the fireman's place who got himself lame at No. 1 locomotive." Here, for the first time, we have an engine number mentioned, which must be that of "Locomotion."

On November 23rd, 1827, he notes: "T.H. directed to order a small jack screw for each engine," and in March, 1828, he notes the receipt of six pairs of screw jacks from Messrs. Stephenson, their cost in the ledger being given as £30 12s.

A sketch of a locomotive axle, dated January, 1828, shows it as a plain bar, 4in. diameter and 63in. long. An extra inch had evidently been added to the length to suit the wider wheels.

On February 5th, 1828, "No. 4 locomotive, Rt. Morrow, got a set of new rims." This shows that engine No. 4 then had two-piece wheels. Morrow is said to have been the first driver of No. 2.

On March 19th, 1828, "One of the locomotives, No. 5, burst the tube, one man was blown 24 yds., John Gillispy sore scalded, the other Edw. Corner about 16 yds., his thigh broke." James Stephenson was the engine tender, and he omitted to unlock the safety valve while the engine was stopped to allow some horse wagons to pass, with the result that the tube burst.

James Stephenson had to appear before the Railway Sub-Committee on March 21st, at which meeting Hackworth was instructed to have the locomotives tested every four months. At the same meeting it was resolved to fine the locomotive men "10/– if the valve spring is not taken off immediately when the engine stops, 10/– also if they do not lock the engine every night, 10/– also if the engine tender leave his engine in the absence of his fireman."

James Stephenson is said to have been the first driver of No. 1, but he was certainly not driving it at this date.

On April 9th, 1828, Hackworth records that he "set Morrows locomotive engine off. Repd the stalk and exhaustion pipe also, a new firedoor and fraim, new front plate and bars grate etc. new crosses & square to parallel motion, new tops to pillars & brass parallel motion, weigh bars, 1 new brass force pump clack &c., keys and washers for pillar cotters etc. 1 new swing bearing all the joints fit up new." This engine would be No. 4 if Morrow was driving the same one as on February 5th.

On May 14th and 15th, 1828, Hackworth was "at Newcastle, Rt. Stephenson & Co., ordering a fire tube for the boiler that burst." This was presumably for No. 5, whose flue burst on March 19th, and Hackworth notes the receipt of the new tube on May 19th.

The ledger records the supply of this tube under date May 21st as "1 Tube for Trav. Engine boiler & 6 pieces of flange, 16 c. 2 qr. 1 lb. @ 34/– £28.1.4."

The notebook gives an interesting table of the earnings of five locomotive drivers for the month of April, 1828, as follows:—

	£	s.	d.
Jas. Stephenson	18	5	4
Rb. Morrow	18	19	4
Wm. Gowland	37	8	11
M. Law	22	18	1
Jn. Cree	22	5	5

Here the five drivers are the same as those of September, 1827, although there were now six working engines, of which No. 5 was out of action, but its March driver, Jas Stephenson, was still working, presumably with the spare engine.

On July 1st, 1828, "John Cree going down the line No. 1 locomotive at Aycliff Lane, while getting water the engine exploded. Cree died on 3rd."

The ledger records the supply of a new tube on August 13th.

Tomlinson gives a summary of the work done by the engines from October, 1827, to December, 1828, extracted from the Leaders Book. This is as follows:—

	No. of days working.	Coal led, tons.
James Stephenson ...	260	14,366
Robert Morrow	271	15,356½
Wm. Gowland	269	20,231
Mcl. Law	244	13,911
John Cree	125	6,456
Ed. Corner	79	4,230

Cree killed July 1st, 1828, at No. 1.
Corner started leading, Sept. 5th, 1828.

It will be seen that the names of the drivers only are given. It would appear that Edward Corner was appointed as a driver to succeed Cree, so that at the end of 1828 there were still five drivers, although there were now seven engines available for work, viz.:— The first five Stephenson engines; the "Royal George," which had started work in November, 1827; and the "Experiment," which reappeared after rebuilding at the middle of September.

The last entry in Hackworth's notebook is dated September 19th, 1828, and reads: "T.H. at Newcastle, ordered travelling engine boiler tube, gave proper directions about malleable rings, wheels; also gave directions about a locomotive boiler and two double tubes &c."

This last sentence, together with some evidence in the Stephenson ledger, has led the writer to propound the theory that Hackworth's "Victory," a six-wheeled engine similar to the "Royal George," and said to have been built at Shildon in 1829, was, in fact, a transformation of one of the earlier four-wheeled engines.

The ledger records the supply of this boiler on November 19th, 1828:—

S. & D. Ry. Co.

	c.	qr.	lb.		£	s.	d.
For 1 boiler and double tube	66	3	17	@ 35/–	175	3	9
1 duplicate tube ...	33	0	13	@ 35/–			
2 chimneys & roots	7	0	20	@ 40/–	14	0	8
1 stay in 3 pieces ...	0	3	6½	@ 46/8	1	17	8
Rivets	0	2	14	@ 35/–	1	1	10
					192	3	11

Now it would appear that this return-flue boiler was originally intended to be fitted to one of the four-wheeled Stephenson engines, with a view to improving its steaming capacity. Its weight, however, was 11 cwt. more than that of the single-flue boilers of engines Nos. 2–5, and its flue was heavier than that of the 10ft. return-flue boiler of the Darlington "Rocket," supplied by Messrs. Stephenson on September 25th, 1829. We know, from a drawing of 1831, that the boiler of the "Victory" was 13ft. long and 4ft. 5in. diameter, and calculation shows that a boiler of this size would have a weight similar to the Stephenson boiler of November, 1828.

With this large boiler the laden weight of a four-wheeled engine with two-piece wheels would amount to 8·9 tons, which is within 0·5 ton of the laden weight of the "Experiment." It is probable, therefore, that it, too, would be found too heavy for the rails, and it may be suggested that Hackworth then decided to remodel it as a six-wheeled engine, using its new large boiler, and at the same time to provide new cylinders, &c., of the "Royal George" pattern. This theory is further supported by the fact that the ledger in April, 1829, recorded the supply of two bored cylinders, the weight of which was identical with the weight of the cylinders supplied for the "Royal George" in August, 1827, and may have been cast from the same patterns.

There is, however, no clue as to which engine was so treated, but the transformation must have been completed after the delivery of the Darlington "Rocket" in September, 1829, as the "Victory," in later lists, is given the next following number.

Very little authentic information is available about these engines after 1829. Pambour's statement of the work done by them from July to December, 1833, which was probably obtained directly from Hackworth, shows that engine No. 1 then had a boiler with a flue and two returning tubes, engines Nos. 2 and 3 had boilers with a single flue, while No. 4 was taken to pieces. This suggests that the boilers and cylinders of Nos. 2–4 were then unaltered. Little can be gathered about the earlier S. and D. engines from Pambour's brief description, although he said that all the engines were supported on springs.

Francis Whishaw, in "The Railways of Great Britain," 1840, describes the engines as he saw them in 1839, when he was collecting information for his book. His account is as follows:—

"No. 1, 'Locomotion,' on 6 wheels, weight of wheels 54 cwt. Cylinders 10in. by 24in., sunk in boiler, 1 return tube. Fire tube 24in. diameter."

"No. 2, 'Hope.' Vertical outside cylinders 11in. dia. by 20in. stroke, 6 coupled wheels, return-tube boiler with 26in. fire tube. Remodelled by Kitching."

"No. 3, 'Black Diamond.' Four solid wheels, sloping cylinders, 10½in. diam. by

18in. stroke, fire-box 2ft. 3in. diam., 107 tubes. Nett weight 10 tons."

"No. 4, 'Diligence.' Remodelled by T. Hackworth, six-coupled wheels, outside vertical cylinders, 16in. diam., 106 tubes."

From this it will be seen that all four engines had new boilers and all except No. 1 had entirely different cylinder arrangements. No. 3 was the only engine still on four wheels.

The Prussian engineers, in their general statement about the Stockton and Darlington locomotives, stated that their power, calculated on the cylinder dimensions of 9in. diameter by 24in. stroke, with a steam pressure of 52 lb. per square inch, would amount to 15 H.P., whereas they actually attained only 10 H.P. Their load was from 16 to 20 chaldron wagons of coal, and, in good conditions, as much as twenty-four wagons, at a speed greater than could be attained by horse traction.

This statement of the actual power is in agreement with Nicholas Wood's experiments on the Killingworth engines, which showed that their single-flue boilers could not supply steam fast enough to keep the boiler pressure up to 50 lb. when the engines were running, but that the pressure actually fell to about two-thirds of its nominal amount.

The writer's reconstruction of the S. and D. locomotives Nos. 2–5 is shown in Fig. 2, and some explanation of its constructive detail will be desirable.

Commencing with the boiler, this, as already stated, had a length over the dished ends of 11ft. 6in. a diameter of 4ft. 6in., presumably outside, the plate thickness being 0·5in. The fire tube was 25in. diameter, presumably inside, and calculation shows that its plates must have been $\frac{7}{16}$in. thick to agree with the weight given in the ledger. The barrel is built up of three parallel rings, each composed of six plates, so as to keep the plate sizes down to those commonly obtainable at the time. The flue is similarly made in three rings, each consisting of two plates. Single riveted lap joints are employed throughout.

The dished ends were made in two pieces and were attached to the barrel by internal angle rings. The flue projected beyond the ends of the barrel and was secured by external angle iron rings. In the top of the barrel were cut two holes for the cylinders, a manhole and small holes for the safety valve and the steam regulating valve. The upper half of the barrel was lagged with wood.

The chimney appears to have been 20in. diameter, with an expanding root, by which it was bolted to the end of the flue tube. The height above the rails, according to the Prussians' report, would be 15ft., and calculation shows that the plates must have been $\frac{1}{8}$in. thick throughout, to suit the chimney weight given in the ledger. The top of the chimney was ornamented by having deep V notches cut in it, these being shown in the Brewster and Rastrick sketches.

The upper half of the rear end of the fire tube was closed by a cast iron plate, which carried the fire door and also supported the rear ends of the fire-bars. The front ends of the fire-bars were supported on an iron cross bar incorporated with the fire-brick partition and bridge which closed the front end of the ashpit. The grate was 4ft. long and, from the weights given in the ledger, and by Rastrick, seems to have been composed of twelve bars weighing 21 lb. each.

The boiler, being larger in diameter than that of No. 1, had to be placed as low as possible on the frame in order to make the connecting-rods 8ft. long with a cylinder projection of 12in., as given by the Prussians. This involves placing its underside 4in. above the axle centre. As half the weight of the engine was borne on the trunnions of the pivoted axle-box, it was necessary to mount the trunnion bearings on a strong cross bar of the frame, or on the boiler itself, as indicated on the original drawing of No. 1, and this, no doubt, was the reason for placing the boiler so low. In engines Nos. 2–5, however, instead of fastening these bearings to the boiler, it was thought better to form them on the front cross bar of the frame, which is curved downwards slightly to fit round the boiler. This scheme seems to agree best with the short frame length of 8ft. 2·5in. given by the Prussians.

This arrangement implies that no front draw-bar was originally contemplated, but the Brewster woodcut shows that the engine represented had, at that time, a front draw-bar, apparently attached to the front axle-box and extending beyond the chimney. In addition, a front extension to the frame had been fitted, presumably to serve as a fender or buffer beam, and its end was supported by stays from the boiler front. The rear end of the frame comes near the end of the boiler, so that the tender could be coupled closely to it.

The boiler was supported on the frame by four short cast iron pillars with square flanges at the bottom and oval flanges at the top.

With regard to the pivoted axle-box, the original drawing of No. 1 shows it as a solid tube fitting closely to the axle throughout its length, the metal being $\frac{1}{2}$in. thick. There is no sign of any clearance in the middle or of brass bushes at the ends. It is known that Nicholas Wood, as the result of experiments made on axle bearings, preferred plain cast iron, and the Killingworth engines were usually so fitted. This practice seems to have been continued on the early Darlington engines, as there is no indication in the Stephenson ledger of any spare brasses being supplied; if brasses were used they would have been one of the chief items needing replacement. Possibly it was thought that such a large bearing area would make these axle-boxes very durable, and as far as the ledger records go only four additional boxes were supplied to the S. and D. Company, these being in May and June, 1826.

Not only were these axle-boxes without brasses, but, on the ledger evidence, it would appear that they were not even bored. Generally, where machining was done on spare parts, this is distinctly mentioned in the ledger entry, and an additional charge made for it, the items themselves being charged as material only, in accordance with their weight and price per hundredweight. It is possible, however, that these axle-boxes were cast on a chilling mandrel.

The ledger entries concerning the supply of such axle-boxes show that there were tubes of three different weights, all in the neighbourhood of 2 cwt., one of which agrees very closely with the calculated weight of the trunnioned box shown on the No. 1 drawing. Calculation also shows that a similar box without trunnions, but with two flanges for attaching it to the engine frame, is slightly heavier and agrees with the second weight given, while the third represents a box made in two parts bolted together, so that it could be fitted on the axle without removing the wheels. The only recorded example of the latter was supplied to the Stockton and Darlington Railway in May, 1826, the necessary screw bolts and nuts being included in the entry.

Now, with a rod-coupled engine the axle centres must be maintained at the proper distance apart, but the central trunnion bearings seem hardly rigid enough to secure this condition against the action of the side rods. It would therefore appear to be necessary to provide guides on the frame for the ends of the pivoted axle-box. This could be done by angle brackets bolted to the frame behind each end of the axle-box, and by providing the box with flat faces where it bore against the guides. There is not sufficient space above the axle-box to permit the use of a bolted-on two-horned guide, but this could be done if the horns were cast on the frame; the latter arrangement has been adopted.

The original No. 1 drawing shows the axle-box trunnions housed in solid eyes, an inconvenient arrangement for easy removal. These bearings were more probably formed as open half-plummer blocks similar to the ordinary locomotive bearings of the day. The axles themselves were 4in. diameter.

As already stated, the original wheels of "Locomotion" and engines Nos. 2–5 must have been similar to those of the Killingworth engines, and the front wheels in the drawing, Fig. 2, are shown of that pattern. They had eight straight spokes, the crank pin being fitted in a boss formed halfway along a thicker spoke, that spoke being connected with the adjacent spokes by a curved rib. The nave and crank pin boss were strengthened against bursting by wrought iron hoops shrunk on.

One wheel on each axle had a crank pin with a large spherical part for the connecting-rod, while from this projected a stem terminating in a smaller ball for the coupling-rod. The other wheel of the pair had a similar pin on the end of which was forged a curved crank arm carrying a ball pin for its coupling-rod in a position at right angles to its main crank pin. The return cranks were thus on the diagonally opposite wheels, this arrangement being essential, as one or other of the coupling-rods must be in a position to carry the cranks of either axle over their dead points. It was also necessary for the excentric shaft drive from the coupling-rods by two cranks at right angles.

The Prussians stated that the return cranks were curved, and they were shown thus on the Killingworth engine illustrated in Wood's "Treatise" (second edition, 1831). "Locomotion," however, now has straight cranks, as were those shown on its original drawing, while the Brewster woodcut agrees in this respect.

The weights of the cranks and pins are quoted in the ledger, so that they can be reconstructed with considerable accuracy. The pins and cranks were keyed in the wheels to fix their angular positions, and were also secured by inside cotters which drew the pin tight against a collar. The transverse distance between the connecting-rod centres was 5ft. 6$\frac{1}{2}$in. and between the coupling-rods 6ft. 3$\frac{1}{2}$in.

From the classified weight of castings in the foundry account of June, 1826, an attempt was made to discover the identity of the parts included in each price group, a task greatly assisted by the weights of some replacement parts recorded in the ledger. For instance, it is fairly evident that the highest price would apply to the cylinder castings, and this was confirmed by a calculation of the weight of the cylinder when its exact design was settled. Each cylinder casting therefore weighed 3 cwt. 5 lb., exclusive of covers and valve chest.

It was also clear that the wheels, calculated to weigh nearly 17 cwt., must be put in the 18s. 8d. group. Thus by making approximate designs for the parts, calculat-

ing their weights, and eliminating the items of known weight, it became possible to say with a fair degree of accuracy which items belonged to each group, and to shape the unknown parts to fit their presumed weights.

It will be noted that in this list of castings material for only two tenders is included, which tallies with the order for two engines.

The cylinder castings were made similar to those of the previous Killingworth engines, being sunk halfway into the boiler with a large flange round the middle for securing them. The size of the steam ports was indicated by the Prussians' statement that the valve travel was 2in. The ports were led to a flat face occupying the whole length of the projecting part of the cylinder, and to this was bolted a separate valve chest provided with outward projecting flanges at the sides, while the lower end fitted closely against, and was bolted to, the large flange. A hole in the bottom of the chest, coinciding with a corresponding hole in the cylinder flange, permitted steam to enter the valve chest. The chest cover was a flat plate with a semi-circular top.

Inside the boiler the valve chests were connected by pipes with a nearly central conical plug cock, the spindle of which projected through a stuffing-box where a lever was fitted on it.

The side flanges of the valve chest were extended upwards to form supports for the bearings of the valve countershafts, and were joined at the top by a semi-circular arch which carried a guide for the valve spindle.

Wings projected from the upper flange of the cylinder to carry the longitudinal bars which supported the bearing pillars of the parallel motion and the end bearings for the valve countershafts.

A single exhaust pipe was provided, connected with both cylinders and terminating in an upturned end in the chimney.

The pistons and their packing are of some interest, and from the cylinder dimensions appear to be 4in. deep. This dimension is confirmed by the weights given for replacements, which also show that they were of cast iron. Now, the *Newton's Journal* account of "Locomotion" says that its pistons were packed with hemp, but George Stephenson's letter of May 3rd, 1826, already quoted, suggests that one or both S. & D. engines, Nos. 2 and 3, had been fitted with brass piston rings; that rings and not pistons was meant, is indicated in the ledger by the number of brass piston rings supplied, the earliest examples weighing 10 lb. each.

This is the first record of the use of metallic packing on locomotives by Messrs. Stephenson, although such packings, of more or less complicated design, had been invented previously and used on stationary engines.

From a knowledge of the size of the piston, it became apparent that this packing was a single ring, 2¼in. wide and 0·5in. thick, cut across at one point. Most metallic rings of that period depended on separate internal springs to force them against the cylinder, and the idea of utilising the elasticity of the ring itself to supply this pressure had not yet been applied.

The rings on the Stephenson pistons were evidently pressed outwards by hemp gasket packed behind them and squeezed down by a junk ring similar to that of an ordinary hemp-packed piston. Tredgold, in 1827, illustrated this arrangement applied to Jessop's helical ring, but we have absolute confirmation of its use by Messrs. Stephenson and Co. in the existing cylinder of an engine supplied by them to the United States of America in 1829, and now preserved in Washington. When this cylinder was opened up a few years ago it was found that the piston still retained this form of metallic packing.

The slide valves were of brass fitted in an iron bridle into which the valve spindle was screwed. The end of a lever on the valve countershaft engaged with a slot formed near the upper end of the spindle, the end of which passed through a brass guide. The valve countershaft was extended on one side, and its end carried a handled lever provided with a pin to which the excentric rod was connected by a notch and sliding catch.

The main excentric shaft rotated in a centre bearing and two end bearings mounted on inclined pillars bolted to the sides of the boiler, and with their upper ends stayed laterally. The loose excentrics were mounted on this shaft and were driven by pins projecting from two collars fixed on the shaft, one on each side of the excentrics. These pins entered semi-circular slots formed in the excentric discs and drove them when con-

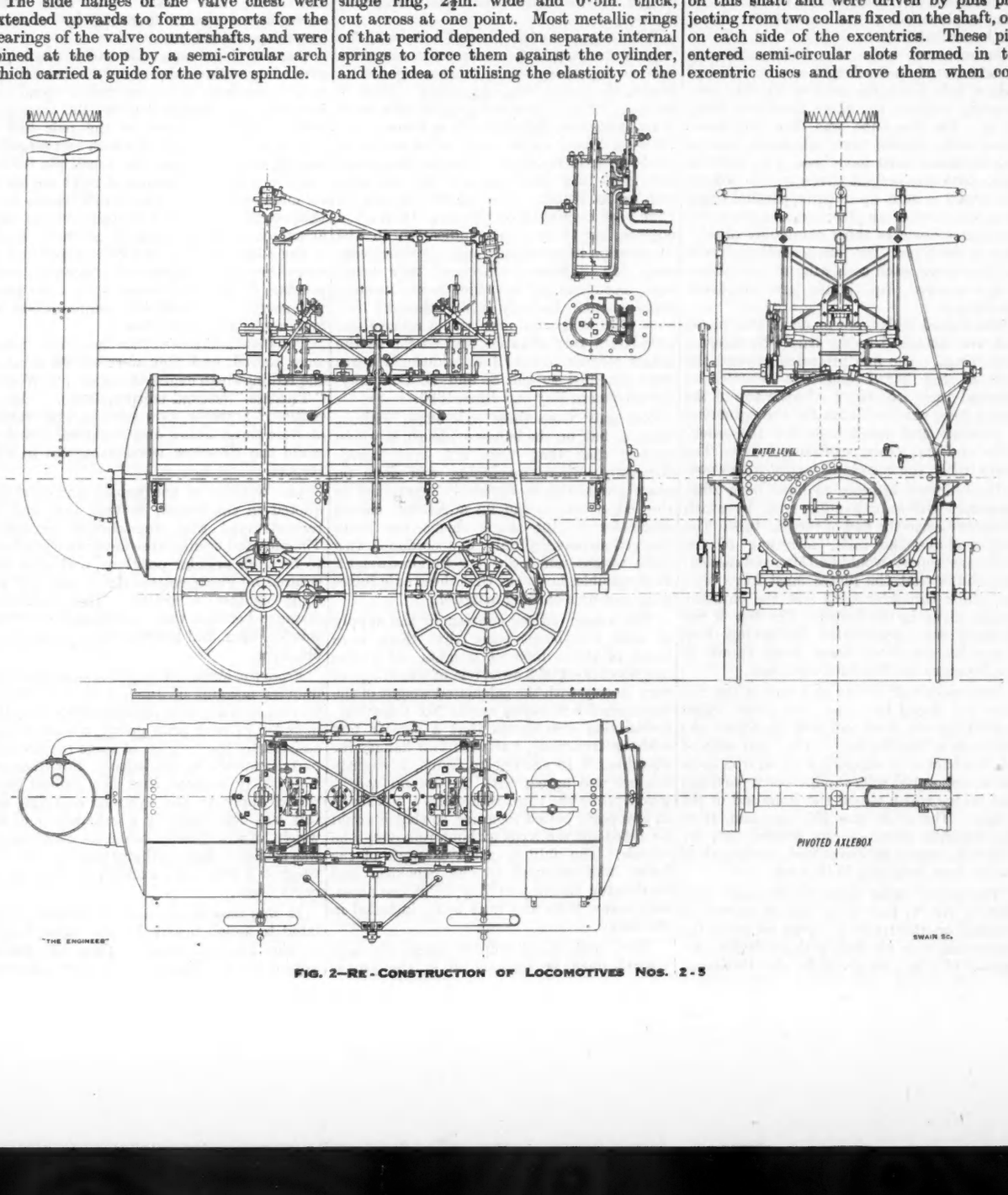


FIG. 2—RE-CONSTRUCTION OF LOCOMOTIVES NOS. 2-5

tacting either end of the slot. The pin when at one end of the slot gave the forward motion, and at the other end gave the backward motion.

The vertical rods which join the valve shaft cranks with the coupling-rods are shown with adjustable brasses at the crank pin end, while their lower ends were forked to embrace the coupling-rods, to which they were attached by transverse pins.

The crossheads were solid wrought iron bars of uniform thickness, but tapering in depth towards the ends where they terminated in balls, 1¾in. diameter, for the attachment of the connecting-rods. At its centre each crosshead was pivoted on a transverse pin passing through the jaws of a forked piston-rod head, so that it could tilt in unison with the axle motion.

Ball pins, mounted on brackets projecting from the side of the crosshead, were provided for the attachment of the ends of the half-beams of the parallel motion, but no provision seems to have been made for differential action between the half beams when the crosshead tilted, as both countercranks appear to have been fixed to their shaft. Perhaps any such motion was supposed to be taken up by the working clearances at the joint pins, or by the spring of the half beams.

Adjustable brasses were provided at the crosshead ends of the half beams and at their points of attachment to the countercranks, but pins working in plain holes served for the top and bottom bearings of the oscillating pillars, the latter being bolted to the underside of the cylinder bars. In order to permit the overlapping of the half beams, the inner ends of one pair were offset and were attached to the crossbar of their pillar nearer to the centre line of the engine. The crossbar at the top of the other oscillating pillar had to be omitted. The details of the valve gear and parallel motion follow generally those now on "Locomotion."

The connecting and coupling rods were of circular section and tapered towards the ends. On the chain-coupled Killingworth engines the connecting-rod ends were of solid, elongated, loop form with a wide opening through which the double-flanged brasses could be inserted and then passed to the end where they were secured by the usual gib and cotter. For the rod-coupled engines, strap ends were necessary for the crank pins, but the solid ends may have been retained for the small ends and perhaps for the side rods also. The ledger shows that a number of spare strap ends were supplied for the S. & D. engines, so that they were probably adopted afterwards for all the rod ends, as now seen on "Locomotion." Many brasses for connecting and coupling rods were supplied from the middle of 1826 onwards, and the weights given help to check their dimensions.

The drawing Fig. 2 shows solid small ends for the connecting-rods and square strap ends for the coupling rods.

A platform, 9in. wide, was provided at each side of the boiler just above the wheels, to enable the engineman to get at the working parts, but these platforms must have been almost untenable, except at the ends, when the engine was running, as two connecting-rods and a valve coupling rod were continually sweeping over each side. Starting and reversing must have been hazardous operations, as although this could be done by one or other of the cylinders, it involved the engineman's close proximity to those sweeping rods. It was necessary also to arrange for the steam regulator to be operated from both ends of the platform, this being done by a longitudinal rod attached to the lever of the cock and provided with a handle at each end. A seat for the driver was placed at the rear end of the boiler and from this he had command of the regulator. The safety valve was of the weighted lever type.

The Prussians stated that, in these engines, the feed pump was driven from one of the half beams, instead of being operated directly from one of the crossheads, as in the Killingworth engines. This appears to have been necessary because, with the larger boiler, there was insufficient space between the boiler and connecting-rods to accommodate the pump. This implies a pump of shorter stroke which could be driven conveniently from one of the counter-crank pins, which had a vertical motion of nearly 12in. There was, however, a considerable offset from this pin to the centre line of the pump, which was bolted to the side of the boiler, so that an inclined connecting-rod was required, together with a guided crosshead for the pump spindle. The ledger gives details of replacement parts for two such pumps supplied in October and November, 1827, the receipt for one of which was noted by Hackworth as being for the old engines. A design to fit these particulars would have a piston diameter of 1·75in. and a stroke of 11·6in., with a box containing suction and delivery valves, the latter leading to a separate clack box fitted with a valve which could be held closed by a screwed spindle. The water was brought from the tender through a leather hose pipe coupled to the pump suction pipe.

The weight of the engine has been calculated and the following summary gives some details of this :—

	cwt.	qr.	lb.
Iron castings	41	2	27
Boiler and chimney	58	3	25
Other wrought iron parts	15	0	16
Brass parts	2	0	0
Fire-bars and brickwork	3	0	15
Timber	2	1	26
Total	123	1	25

Of this total of about 6 tons 3 cwt., about 50 per cent. is checked by the ledger weights. The calculated weight of the water in the boiler, with the water level 4in. above the flue, is 34 cwt. 1 qr. 4 lb., and the coal on the grate would weigh about 1 cwt. 3 qr. 4 lb. The total weight in working order was thus 7 tons 19·5 cwt.

Calculation shows that the centre of gravity of the unsymmetrical parts of the engine was situated 2in. behind the middle of the boiler barrel, so that, if the wheels are placed symmetrically under the boiler, the weights on the two axles will be very nearly equal.

The Prussian engineers gave the unladen weight of these engines as about 132 cwt., which is rather more than the calculated weight when one-piece wheels, weighing about 17 cwt. the set, were included. Possibly their figure covered wheels of the two-piece type.

We have ledger figures for this type of wheel made during 1826 for the Mount Moor engines, and having eight spokes; these weighed 25 cwt. 3 qr. 24 lb. for the set of four wheels. The heavier twelve-spoke wheels seen by the Prussians on engine No. 5, early in 1827, weighed 27 cwt. 3 qr. 9 lb. the set.

The substitution of the first of these for the one-piece wheels would bring the unladen weight to about 6 tons 12 cwt., while the second type would bring the weight up to nearly 6 tons 14 cwt. The corresponding laden weights would be very closely 8 tons 8 cwt., and 8 tons 10 cwt.

The lowest weight of 7·98 tons agrees with Walker and Rastrick's figure of 8 tons, while the other weights conform to Robert Stephenson's statement, made in 1829, that the S. and D. small engines did not exceed 8·5 tons laden.

In the drawing Fig. 2 the hind wheels are shown of the twelve-spoke, two-piece type of March, 1827.

This story of the Stockton and Darlington Railway locomotives Nos. 2–5 may fitly conclude with a few of the ledger extracts relating to spare parts supplied for them, other than those already mentioned.

			£	s.	d.
Oct. 19th, 1826.					
8 brass rings for packing pistons	81 lb.				
36 connecting rod brasses	38	@ 1/2	7	1	2
8 rings for packing stuffing boxes	2				
Packing box				1	6
Turning rings, fitting up brasses			7	0	10
			14	3	6
April 14th, 1827.					
20 small brasses for Trav. Engines	0 0 9				
16 small connecting & side rod do.	0 0 22	@ 1/2	2	14	10
2 brass piston rings	0 0 16				
Nov. 3rd, 1827.					
1 Trav. Engine Chimney	3 0 12	@ 37/4	5	16	0
Jan. 11th, 1828.					
6 Connecting rod ends and 6 straps and 18 keys	1 0 4	@ 74/8	3	17	4
62 brasses	84 lb.	@ 1/4	5	12	0
6 small brass clacks	@ 2/8 each		0	16	0
			10	5	4
Jan. 14th, 1828.					
2 Cranks	0 3 0	@ 56/–	2	2	0
Turning cranks & pins			0	15	0
4 axles for Trav. engines, turned	7 3 5	@ 28/–	10	18	3
2 cylinder covers	0 3 10	@ 16/4	0	13	8
4 glan bolts	0 0 3	@ 56/–	0	1	6
1 brass glan	0 0 3	@ 1/4		4	0
Boring and turning glan			0	7	0
			15	1	5
July 5th, 1828.					
3 brass safety valves & lids	24½ lb.	@ 1/2	1	8	7
Turning do.			1	2	0
			2	10	7
Nov. 24th, 1828.					
4 Trav. Engine Wheel rims hooped with iron and turned	20 1 0	@ 28/–	28	7	0
Feb. 26th, 1829.					
6 gauge cocks		@ 5/6	1	13	0

Air Force Targets in Germany

No. XXIII

(*Continued from page 118, August 22nd*)

The Port of Stettin

ON the nights of Monday, September 29th, and Tuesday, September 30th, heavy attacks were made by a powerful force of aircraft of Bomber Command on the Baltic port of Stettin, Germany's most important sea base in the Baltic Sea. Among the aircraft which made these two raids were Wellington, Whitley, Stirling and Halifax bombers, and a Czech squadron took part in the operations. The weather on both nights was good, and visibility was aided by moonlight. The first machines were over the target by 10 p.m., and it was not until nearly five hours later that the last bomber turned for home. The official Air Ministry reports state that the many waterways in the port

were clearly seen by moonlight aided with flares, and that the principal docks and the railway stations were readily found. As a result of the bombing large fires were started around the railway station and in many sections of the dock system, in addition to fires in the vicinity of other important targets in and around the town.

AERIAL VIEW OF PORT OF STETTIN

The Site of the Port

As will be clearly seen from the accompanying engraving, made from an aerial photograph, the port of Stettin lies on the western arm of the River Oder. It is about 650 miles distant from this country and about 50 miles from Berlin. In many ways it can be considered as Berlin's most important seaport, with which it is connected by a well-planned system of railways, roads and inland waterways. It lies in a position somewhat inland, and the Baltic Sea is reached by a broad and deep channel from Stettin to Swinemünde, which is well lighted and dredged to give a depth of between 27ft. and 32ft. Should it become necessary this channel can be kept clear in winter by the use of five special icebreakers.

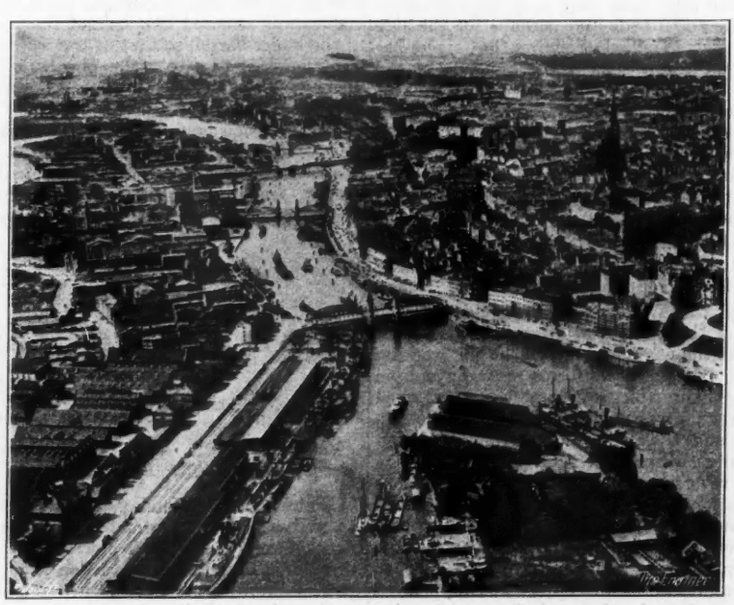
The port has numerous railway connections, both with Central and Eastern Germany, and not less important than the railways are the connections by the autobahn with the Berlin Ring and the navigable river and canal network.

The River Oder is navigable for shipping up to Cosel, a length of about 375 miles, while at Küstrin, where the Oder is joined by the Warthe, there is a connection to Gnesen along a 125-mile length of the river with a further river network of about 175 miles to Bromberg. The Hohenzollern canal, which in recent years has been widened and deepened so that it can take barges of increased capacity, gives direct connection by water to the Berlin district and the centres served by the River Elbe and its canals, while the Finow canal with its important ships' lift near Hanover provides a connection with the Ruhr and Rhine areas. It will be seen, therefore, that the port of Stettin is an indispensable terminus for the transhipment of war supplies which are now sorely needed for the further prosecution of the Russian campaign from Germany's principal centres.

History of the Port

The development of the port of Stettin dates back to the year 1873, when the city was declared a fortress. By 1878 the first harbour was constructed at Dunzig, and it comprised a quay with loading sheds having one railway track between the shed and the quayside and three behind the sheds. The quays, like the sheds, are built on piling, a general idea of which can be obtained from the drawing reproduced herewith. The quay accommodation was continued along both banks of the River Oder and along the north side of the Parnitz channel, and also in other positions in the town.

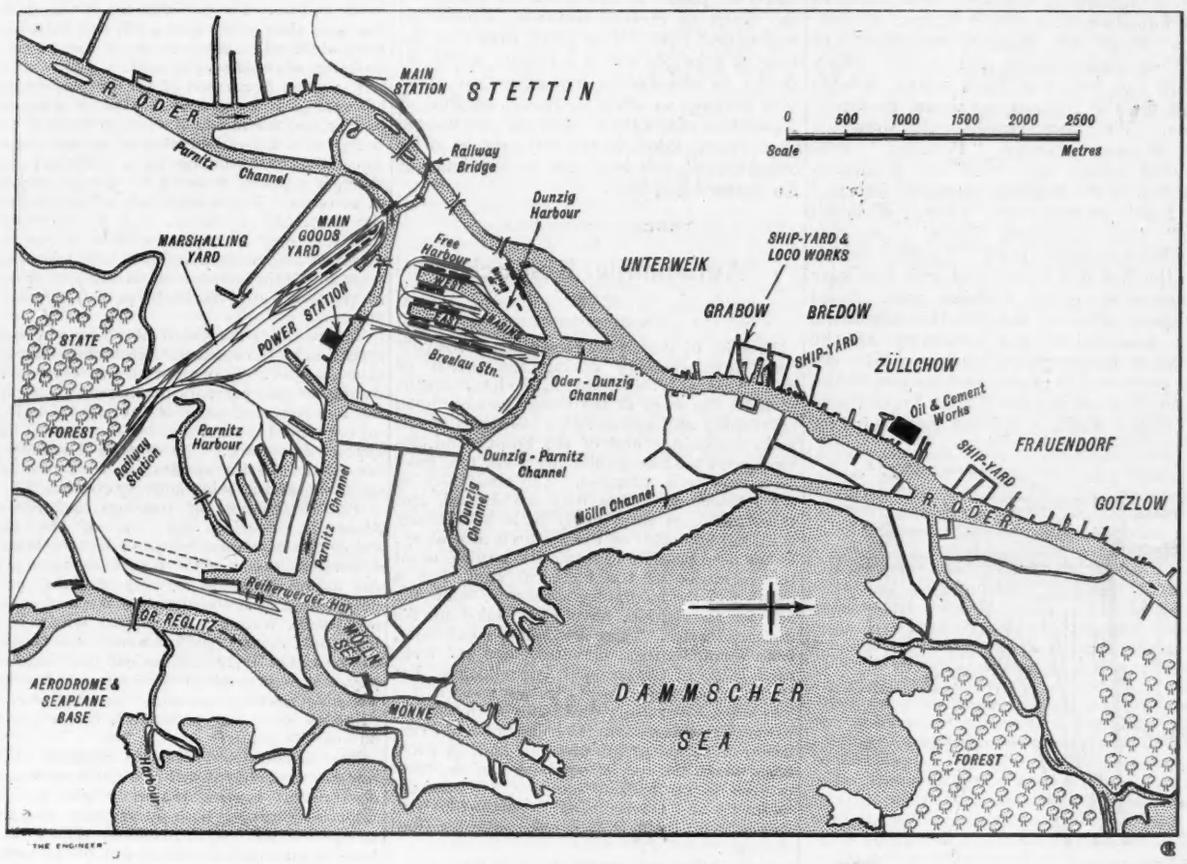
One of our engravings shows the river in the neighbourhood of the main passenger station and also the many road bridges,



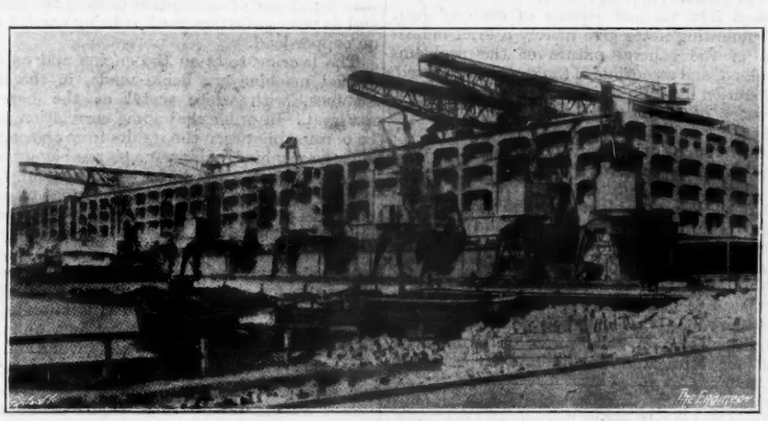
CENTRE OF STETTIN

which, like the railway bridge, are designed as opening bridges in order to allow ships to pass through to the various systems of docks. About 1898 the construction of the Free Harbour was begun, and extensive sheds for the warehousing and loading of goods were built and were served by a number of hydraulic cranes. Part of this scheme included a warehouse and a six-storey granary. From 1907 to 1908 other sheds and basins were constructed and later the east and west basins were completed with larger buildings and cranes. Shortly before the beginning of the war the Free Harbour at Stettin had a total land and water area of 370 acres. Of this area the east basin has a total of 84 acres and the west basin 40 acres. Both basins have a mean depth of about 37ft. The cranes in the east basin comprised two 5-ton cranes, fifteen 2½-ton cranes, twenty-eight 1½-ton cranes, and a floating crane with a lifting capacity of 40 tons. In the west basin there were one 10-ton crane, one 5-ton crane, twenty 2½-ton cranes, fourteen 1½-ton cranes, and three transportable grain elevators.

Soon after the last war there was a marked revival in the trade of the port, which was then carried on at Parnitz, on the Oder, and at Dunzig, and the Reiherwerder harbours. Among the large variety of imported goods handled at the port before the war, we may mention coal, coke, oil, ores, slag, phosphate, china clay, Chile saltpetre, soya beans, timber, iron, and general cargoes. The principal exports from the port consisted of grain, coal briquettes, timber, paper and cellulose, cement, sugar, iron, artificial manures, and other commodities. The bulk cargoes were generally handled at the Reiherwerder harbour, which is especially equipped for this class of work. The machinery includes four loading transporter bridges, each of 5 tons lifting power, one 10-ton transporter bridge, and four having a lifting capacity of 15 tons each, all of which are equipped with automatic weighing machines. Besides the loading bridges there is a coal tipper with a designed output of 300 tons per hour. At the newer Mölln harbour there are two 6-ton cranes and extensive railway tracks and sidings. The Dunzig harbour has four quay sheds and its equipment, eleven electric cranes with lifting capacities from 1½ up to 5 tons.



PLAN OF STETTIN HARBOURS



COMBINED GRANARY AND WAREHOUSE No. VII

A specially interesting building in the neighbourhood of the Free Harbour is the combined warehouse and granary known as No. VII, which was built about 1928 or 1929 on a site near the east bank of the west basin. It has a commodious cellar and five stories with a flat roof along which run three transporter type lifting cranes. The building has a length of about 690ft., a breadth of nearly 127ft. and a height from the cellar to the roof of about 71ft. On the quayside of the building there are two railway tracks and three tracks on the landward side, with a ramp for road traffic, which utilises entrances at each of the gable ends of the building. At the front of the building there are eight portal type cranes of Demag and Ardelt design. Inside the building are four lifts for heavy goods and spiral conveyors for the quick handling of bagged materials and grain. A feature of this large warehouse and granary is the very complete fire protection, which is designed on the sprinkler automatic principle.

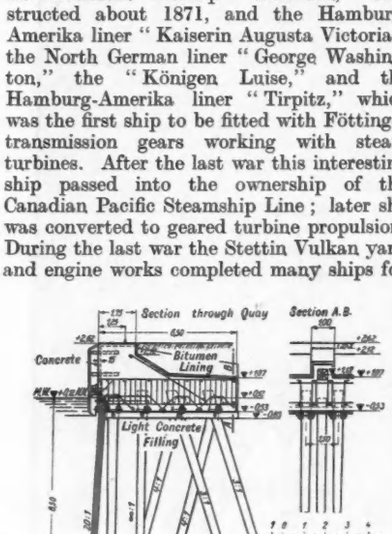
Railway Connections

The accompanying plan of the port of Stettin not only illustrates the many harbours and waterways of the port, but it shows clearly the arrangement of the railways which serve them. The main passenger station in the town and the Breslau Station near to

the Free Harbour are both shown on the map. Other important parts of the railway system are the goods yards and the marshalling yard, shown on the plan, in addition to which there are other goods yards in and around the docks, some of which are not shown.

Shipbuilding and Other Industries

Stettin has for many years past occupied a prominent place in the shipbuilding and marine engineering industry. The Stettiner Maschinenbau A.G. Werk Vulkan, Stettin, is a works at Bredow, established in 1851 as Fruchtenicht and Broek, which before the last war built many notable ships for the German naval and merchant fleets. We may recall such ships as the Prussian warship "Preussen," constructed about 1871, and the Hamburg-Amerika liner "Kaiserin Augusta Victoria," the North German liner "George Washington," the "Königen Luise," and the Hamburg-Amerika liner "Tirpitz," which was the first ship to be fitted with Föttinger transmission gears working with steam turbines. After the last war this interesting ship passed into the ownership of the Canadian Pacific Steamship Line; later she was converted to geared turbine propulsion. During the last war the Stettin Vulkan yard and engine works completed many ships for



Typical Quay Construction

the German Navy, and after the war the building of merchant ships was continued. When the Vulkan Works opened a branch yard at Hamburg the larger ships were built at that port. The production of locomotives and rolling stock and the carrying out of repairs to rolling stock occupied the works for many years after 1918, and about 1922 the works produced up to 300 locomotives per annum. When the Hamburg Vulkan Works were acquired by the "Deschimag" combine the work at Stettin continued to be mainly of an engineering character. The firm originally had seven berths and a number of floating dry docks. Another Stettin shipbuilding and engine building firm is the Stettiner Oderwerke A.G. für Schiff und Maschinenbau. Its works are at Stettin-Grabow, not far distant from the Vulkan yard. This particular firm specialises in the building and repair of cargo ships, and it possesses several floating docks and cranes.

Another yard in the same district is that of Nüscke and Co., which builds and repairs smaller ships up to 300ft. in length and also carries out ship and engine repairs. In the section of the port we illustrate it is not possible to outline the position of all the different works, such as gas and water undertakings, chemical and cement works, catalyst factories, sugar, vegetable oil refineries and other industries all related to Germany's supply programme.

Further up the river towards its mouth is the well-known paper and cellulose factory known as the Feldmühle Works, at Odermünde, which produces paper and cellulose products direct from wood obtained from Baltic forests. At Pölitz, a little further on than Odermünde, there is the famous synthetic oil works, completed a year or two ago under Generalfeldmarschall Göring's four-year plan. It lies about 20 kiloms. to the north of Stettin and was bombed in September, 1940. This plant works on the Bergius principle and is generally similar in design to the Leuna hydrogenation plant near Leipzig, so often an R.A.F. target. A description of the Pölitz oil works, with some photographs taken in the early stages of its construction, will be found in our issue of November 15th, 1940.

Automobile Research*

Introduction

In spite of the trying conditions of the past year, and especially during the period of intense air raids on London in the later months of 1940, the work of the Committee has gone on steadily and successfully. Meetings of the Main Committee and of the Sub-Committees have been held at regular intervals, and have been very well attended. The continuity of the research work has been maintained, and there has been surprisingly little interference with the activities of the research laboratory. It has been possible to retain the services of all the members of the technical staff, but a number of the laboratory assistants, below the age for reservation, have been called up for military service. There is evidence on all sides, from manufacturers, operators, and the technical staffs of Government Departments, that the Research Department can best assist in the war effort by actively continuing both with its research programme, in the collection and circulation of technical information, and, in those cases where the special equipment of the laboratories is particularly suitable, by assisting members and Government Departments with special investigations on problems arising from the war.

Director's Report on Research Work

The progress of the research work may conveniently be considered under the following headings:—Work at the research laboratories; extra-mural research; and the work of the special panels.

Under the first heading, the programme for the past year has included the following subjects:—Aeration and frothing of lubricants, performance and wear of bearing metals, performance of a converted petrol engine running on producer gas, gear performance, and piston ring scuffing. The first two items on this list represent in themselves a number of different investigations into various aspects of each subject. The following notes give merely a brief indication of the general nature of the problems involved, and an outline of the methods adopted.

Aeration and Frothing of Lubricants.—The presence of air in oil may lead to operating difficulties and engine failure. It may produce a large amount of froth in the oil tank, interfere with the performance of the oil supply pump, or reduce the load-carrying capacity of the bearings. The problem has been approached from three different aspects, viz., (*a*) the production of froth in lubricating oil; (*b*) the separation of air from the oil; and (*c*) the effect of aerated oil on bearing performance.

A study has been made of the quantities of froth produced in aerated oil under different conditions of temperature, rate of air flow, &c., and for lubricants of different types. The effects of the addition of small quantities of certain substances to the oil to reduce the amount of froth have also been tested.

The separation of air and oil has been carried out by means of a de-aerator fitted in the oil pipe line. Earlier experiments with an apparatus in which the oil stream was caused to flow in a helical path indicated that the centrifugal force thus exerted could be used to separate a considerable quantity of the entrained air. Systematic tests have been carried out with a second type of de-aerator, in which the separating effect is produced by rotation of the mixture of air and oil. The performance of this device has been thoroughly examined, and data have been obtained which will be of assistance to designers of similar equipment.

The effect of aerated oil on the performance of bearings is being investigated on a bearing testing machine in which a loaded bearing, consisting of a big-end bearing of an aero-engine connecting-rod, running on a hardened steel shaft, is supplied with oil of different degrees of aeration. The temperature of the bearing, the frictional resistance, and the maximum load that may be carried without seizure, are all under observation, and it is hoped from this work to obtain information on those conditions of aeration which are likely to lead to bearing failure.

This research on aerated oil is occupying more attention at the research department than any other subject. Two reports have been issued during the past year, one dealing with the frothing tendencies of different lubricants, and the other giving the results of tests on the rotating type of de-aerator. The work is of immediate importance in its application to aero-engine operation and is being actively continued.

The Performance of Bearings and Bearing Materials.—Bearings are one of the most vulnerable of engine components, and bearing difficulties occur with persistent regularity. An improvement in bearing material or in design may ease the situation for a time, but eventually, with the consequent demands for increased engine performance, the bearing again reaches the limit of its load-carrying capacity, and more trouble is encountered. Research work on bearing operation may therefore be regarded as a semi-permanent feature of the automobile industry.

The experimental work in progress at the research department includes comparative tests on different bearing materials, and tests on full-size bearings, both in engines and in a special bearing testing machine. The work on bearing materials is carried out on a machine in which inertia loading is applied to the bearing by means of a reciprocating mass driven by a crank, the test bearing being fitted as the big-end bearing of the connecting-rod. The bearings are made in the form of bushes, and both the bush and the crank pin may be removed for the measurement of wear. The construction of the bearing is different from that in actual engines, and the usefulness of the apparatus lies in the ease with which comparative data are obtained on the rates of wear of different materials under different conditions of loading and temperature. A report was issued during the year, giving results obtained with a number of aluminium bearing materials, and at present further work is being carried out on copper-lead.

The bearing tests on the engine and on the special machine are being made, in the first instance, with white metal as the bearing material. In order that some correlation may be obtained between the results from the engine and the machine, arrangements are being made for identical bearings to be used on both. The bearings supplied for test cover a range of compositions and thicknesses of the white metal lining.

In this new bearing testing machine, at present in course of construction, arrangements are made for the application of a fluctuating load to the test bearing, and it is intended to measure the friction in the bearing, and the variation in friction during each revolution.

Engine Operation on Producer Gas.—The object of this investigation is to determine the power output of a vehicle engine when converted to operate on the gas supplied by a

* Abstract from the tenth annual report (1940–41) of the Automobile Research Committee of the Institution of Automobile Engineers.

standard type of portable gas producer. Extensive and valuable work on the gas producer and its operation is being carried on elsewhere, and the tests at the research department are confined mainly to the performance of the engine, and to the effect of modifications to the engine and to its accessories.

The maximum output of the engine when running on producer gas is compared with that on petrol, over a wide range of operating conditions, including speed, mixture strength, and ignition timing. The effects of modifications to the engine have been examined, with the object of restoring the power lost when a petrol engine is converted to producer gas operation.

Tests on a 4-litre side-valve commercial vehicle engine have been completed, and a report on this work has been issued. The investigation is being continued with an overhead-valve engine, from which further information is being obtained on the gain in power resulting from increased compression ratio, the addition of a small supply of petrol to the producer gas, and the fitting of a blower to the engine.

Gear Performance.—Many aspects of the operation and performance of gears require investigation, and the research department has been engaged on this work during the last four years. The work carried out has been concerned mainly with materials for high-duty gears, and their durability under test. Failure of the gear tooth surface by pitting and by scuffing has been studied, and also the modification of the tooth profile to allow for the elastic distortion which occurs during operation.

Further experiments have been carried out with different lubricants, in order to examine the effects of various extreme pressure addition agents on the load-carrying capacity of the gears. The breakdown of the film of lubricant between the teeth leads to scuffing of the steel surfaces, and the load at which scuffing takes place is therefore used as a measure of the ability of a given lubricant to maintain a film between the teeth under load. Comparative results have been obtained on a number of addition agents for increasing the film strength of the lubricant, and a report on this work has been circulated to members. These tests are being continued at higher temperatures and over extended periods of service.

The proposed extension of the research work on gears is referred to in the section dealing with the work of the special panels.

Piston Ring Scuffing.—The problem under investigation is the surface failure of piston rings, due to what is generally regarded as incipient seizure following breakdown of the film of lubricant between the ring and the cylinder. As with so many other problems associated with boundary lubrication, the operating conditions leading to scuffing are difficult to establish, and the work has as yet been mainly exploratory in character. Most manufacturers and operators who have experienced trouble from piston ring scuffing have been able to overcome it by the use of special surface treatments for the rings, and it had been proposed to examine the relative merits of different surface treatments in preventing scuffing.

Over-heating of Tyres and Brakes on Buses.—The increased severity of the operating conditions in commercial vehicles, with the heavy loads imposed on the brakes, has resulted in very high temperatures in the neighbourhood of the brake drums. Heat is transmitted through the wheel rim to the tyre, and many tyre failures have resulted from the high temperatures attained in service.

Measurements of brake drum and wheel rim temperatures have been carried out, both in service and under controlled laboratory conditions, over a period of years, and the final report on this work has now been prepared and circulated to members. Various designs of brake drums have been tested, and modifications have been made to the conditions controlling the air flow between the brake drum and the wheel rim. An examination of the results of these tests has indicated those features of the assembly which are important, both in the transfer of heat to the wheel rim and to the tyre and in the dissipation of heat from the brake drum, and it has been possible to suggest methods by which substantial reductions in tyre temperatures may be obtained.

Fatigue Strength of Crankshafts.—The experimental work on this subject is concerned with the resistance of crankshafts to fatigue failure under reversed bending stresses. A report issued during the year gave results obtained with different surface treatments, including nitriding, chromium plating, induction hardening, and metal spraying.

The machines used for this work are of larger size than those generally available for fatigue testing, and are particularly useful for tests on complete components as compared with small specimens. During most of the present year they have been engaged on special tests on engine and aircraft parts, both for aero-engine manufacturers and for the Services, with the result that there is but little information that can be reported. Arrangements are being made, however, to continue with the crankshaft investigation when the machines are no longer required for other urgent work.

Design of Cooling Fins.—In addition to carrying out experimental work, the research department collects and reviews the available information on specific problems. Before any new item of research is undertaken, an examination of the literature on the subject is the first step, when it may be found that the information already available is sufficient for the required purpose. Requests have been received at different times for information on the design of cooling fins for air-cooled engine cylinders, and, as a result, the existing information on heat transfer has been examined in relation to this problem.

In a report recently issued to members, general engine design and installation features have been considered with regard to their effect on the problem of cooling, and the factors controlling fin design have been assessed from published test results. Values of heat-transfer coefficient are given for different arrangements of cooling fins, and the relation between the fin dimensions and the quantity of heat dissipated from finned cylinders is discussed and illustrated.

Reclamation and Repair of Worn Parts.—In view of the special difficulties encountered by operators in obtaining new vehicles or spare parts for existing vehicles, many cases have arisen where work has been undertaken to recondition worn parts and to put them back into service. Such work was a regular feature in the maintenance of the large fleets of vehicles in peacetime, and in many cases operators have developed special methods which they have found to be most suitable for various classes of repair work.

In order that this information might be made available to all members, the individual operators have been invited to supply information on the methods of salvage and repair which they have found to give the best results. This information is at present being collected and prepared for issue in the form of a report.

Extra-Mural Research

Deep-drawing Properties of Materials.—This is the only subject on which work for the Committee is being done outside its own laboratories. The finance for the research is provided by organisations interested in the materials used in press operations, and include the British Iron and Steel Federation, the British Non-Ferrous Metals Research Association, the National Association for Rolled and Re-rolled Steel Products, and a number of individual companies, with an allocation from the Automobile Research Committee.

The investigation is being carried out in the engineering department of Sheffield University, under the direction of Professor H. W. Swift. Two reports have recently been prepared and circulated, dealing with (*a*) a survey of a section of the current literature on deep-drawing, and (*b*) the progress of the experimental work.

The conditions imposed on the material during a drawing operation are very complex, and great difficulty is experienced in assessing the suitability of any material for the production of successful pressings. Various methods of test have been examined, and a machine has been constructed with the object of combining a number of desirable features. Variations in punch load during a pressing have been recorded and the strains in the material at various stages of the operation have been measured. From these data it has been possible to correlate the changes in the material with the applied force, and to examine those factors leading to failure. This work has been carried out both on single-stage and on two-stage pressings.

An additional feature of Professor Swift's work is the fundamental study of plastic strain, and in the course of tests on materials in torsion it had been observed that torsional strain was accompanied by an alteration in the length of the specimen. Further work on this subject has provided additional information on the behaviour of different materials, and a tentative explanation has been formulated.

Work of the Special Panels

In connection with those special investigations which receive additional financial assistance from interested organisations, special panels have at various times been established by the Research Sub-Committee. Such panels have been in existence for a few years for the deep-drawing research and for the work on motor-cycle silencing, but the work on this latter subject was suspended at the beginning of the war. The purpose of the panel is to permit adequate representation of the interests contributing to the research, and to obtain the advice and co-operation of those with special experience in the particular subject. This ensures that the research programme is drawn up to include as many as possible of the problems involved, and that the research workers are kept in touch with the practical implications of their results. Such co-operation is, of course, of the greatest benefit to the progress of the research.

It has recently been suggested that the research on gear performance should be extended, and the programme enlarged to include many problems affecting the designer, the manufacturer, and the user of gears. It was further suggested that, since this subject is of great interest to other branches of engineering outside the automobile industry, non-member firms specially interested in the work might be invited to participate. A conference of representatives of the various interests was held to discuss this subject, and as a result a special panel to deal with the research work on gears has been set up by the Research Sub-Committee, and a comprehensive programme of work has been drawn up. Arrangements have been made for the additional work to be undertaken as soon as the necessary finance becomes available. In this connection, those member firms who are specially interested in gears, as well as non-member firms, will be asked to make a special contribution to this work.

Railways in Syria.—Plans are afoot for the development of rail traffic between Iraq and Syria *viâ* the Mosul-Aleppo section of the Baghdad Railway.

The Control of Roofing Material.—New regulations have been issued by the Director of Roofing, Ministry of Works and Buildings, to take effect from October 6th. Briefly the new system of control permits manufacturers and merchants to sell roofing material, such as Ruberoid, Stavex and Pluvex, to consumers from stock without the necessity of obtaining a permit from the Executive Committee, as heretofore. Merchants desiring to order stocks from manufacturers for delivery to their warehouses or direct to the consumers must obtain a permit from the Executive Committee. The maximum stock of roofing felt which any merchant will be allowed to hold is the equivalent to 250 24-yard rolls of any make. Merchants wishing to take up stocks of roofing felt under the new regulations should either be members of one of the Trades Associations or should have been recognised dealers in roofing felt before the war. This modification of the regulations is intended to make the system of control easier for the industry, but the authorities wish it to be clearly understood that the principle underlying the restrictions previously in force should be continued by distributors, preference being given to all Government orders and those connected with the nation's war effort.

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MAN POWER

WE have before now expressed regret that the number of workpeople employed in the United Kingdom is not now made public. The number *not* employed is announced month by month; but from it the number in work cannot be derived. Like a barometer without a scale, the returns show variations only. Moreover, they are culled from the members of registered associations alone, and are continually vitiated by the inclusion of newcomers upon the threshold of industry. Thus it was in normal times. Now the figures are less than ever a useful guide. The Ministry of Labour knows, no doubt, how many persons are gainfully employed, but the public, and presumably Members of Parliament, do not know. This lack of knowledge gives an unreality to debates on man power. The debaters have to rely on personal impressions or observations; they have no factual data or statistics. Such observations and impressions may be very misleading, and it is therefore to be regretted that the friendly discussion which took place in the House of Commons last week was not held over till the survey of labour which Mr. Bevin is having made was complete. As the matter stood, he made an effective reply to the critics, but, nevertheless, one felt that he will be in a much better position to deal with the subject a week or so hence than he was then. His analysis may enable him to prove that vague charges about the lack of use or the misuse of man and woman power are not substantiated by ascertained facts.

There is a broad way of looking at the problem which may help us to retain a sense of perspective. The total population of the United Kingdom is in the neighbourhood of forty-six millions. Let us assume that the sexes are equal in number. Then we have twenty-three million males of all ages between one day and, say, seventy-five years of age. From this gamut we may exclude all those under sixteen or over sixty. On a rough computation that leaves us with some fourteen to fifteen million employable males. Using the same very approximate computation, we have an equal number of employable females. In other words, about 60 to 65 per cent. of the total population is always at the employable age. But all cannot be working people. Several millions are engaged in the other vocations which are essential to the wellbeing and progress of the nation. In fact, in normal prosperous years some fifteen million males and six million females made up the industrial population of the United Kingdom. Subtracting this twenty-one million from the total of thirty million leaves us with nine million persons of both sexes on which the State could draw for all the extra services it requires for war purposes of all kinds. But a great proportion of it cannot be touched. Hundreds of thousands have been called to the Colours, a very large number of the women must be retained for domestic duties and motherhood, forty to fifty per cent. perhaps; and there is a percentage of invalids and defectives. Possibly, then, the actual pool does not exceed three millions. If that be a fair estimate, it would seem that the maximum number of people that could be employed on the war effort, excluding the Services, is about twenty-four millions in all. This is an extremely rough computation. It is based on the latest pre-war—1931—figures given in Whitaker and may err considerably; but it does, at any rate, give a crude idea of the resources in man and woman power, and its very vagueness helps us to appreciate how valuable a statement of the number of persons employed—*not* unemployed—would be. Perhaps when Mr. Bevin's investigation is complete he will be able to show, even without revealing facts which would be useful to the enemy, that the country has really approached closely to the full use of its man power.

Let us now turn to the debate itself. We may note, in the first place, that if Sir R. Glynn is correct, our estimate of man power is too high. According to him, "there are not more than eighteen millions who are available for work of any kind." We do not know what age limits he has taken, but we have some recollection that on some occasion eighteen million was mentioned by a Minister as the total available pool of labour. If that be so, then our argument that at the present moment there is not a large reserve of unused labour is strongly reinforced. As a matter of fact, the discussion turned less on the failure to employ than on mis-employment. It seemed, indeed, to be generally accepted that the whole available man power of the kingdom had been mobilised and that the only remaining source of labour was to be sought in woman power. Speaker after speaker touched upon either the waste of man power from one cause and another, or upon the folly of denuding certain trades and industries of labour in order to satisfy the requirements of other industries or the three Services. As Mr. Bevin put it in his reply, "Everybody who has spoken to-day has told me from where I have not to call people up. I cannot recall a single speech which has suggested from where I could call them up." On the question of the proper utilisation of man power, the House was treated to a number of interminable speeches on what have become familiar lines. That there is some inefficiency goes without saying, but that it is rampant has not been proved and cannot be proved by single examples falling within the personal knowledge or experience of individual Members of Parliament. Nothing less than a thorough investigation by a Commission of all the war industries from one end of the kingdom to the other could hope to show the true position. The evidence of output—let us say of tanks and aircraft—does not support the charges that have been made. On the contrary, it would seem to show that, to say the least, a reasonably high standard of efficiency has been reached. The real gist of the whole matter appears to be a battle between the Services and industry to secure man power. On this Mr. Bevin was asked very properly, "Is there a plan for the utilisation of the man power of the country? Have the Government made up their minds as to the allocation of man power between the Armed Forces and essential industries? Have they made up their minds as to the utilisation of the whole man power of the country?" To those questions Mr. Bevin replied: "Of course we have a plan, but if anyone thinks that we started out with a plan at the begininng of the war and that we shall finish up with exactly the same plan that assumes that the situation never changes and that we never have to change the plan." Continuing, he said: "It must be remembered that the whole of these factory arrangements were organised, quite properly, on the assumption that France would remain in the war. But she did not, and one of the steps which we took was at once to cut down a lot of the factory building in order to concentrate on others and bring them into production at the earliest date." Planning for war production is something like planning a battle. The general plan of campaign may be laid down, but it must be modified to some extent by events as they arise. As we have said, it seemed to be accepted that, women alone excepted, nearly all the available power was being allocated to war work, yet, if our memory serves us, no one touched upon the

enormous clerical staffs in the service of the Crown and military services. One cannot help wondering if some of it is not redundant, and if there is not in public offices a yet untapped well of woman, if not man, power for industry.

If it should appear from what we have said that we take too rosy a view of the efficiency with which the available man power of the kingdom is being used, let us say at once that we hold no brief for the Government or for Mr. Bevin. On the other hand, vague and unbalanced charges are repugnant to us. The true position cannot be discovered by the examining of gross cases of inefficiency or occasional examples of square pegs in round holes, or the denuding of industries here and there by the recruiting of labour for arms or industry. The war effort must be looked at as a whole; it cannot be fruitfully examined piecemeal. The War Cabinet alone has all the threads in its hands. They must be moved from day to day as circumstances require. A constant plan—so dear to many people—is impossible. Changes and disturbances of routine are inevitable, and they must give rise to inefficiency. We have to accept that as an inescapable fact. War is an inefficient business, however you run it.

Raw Materials and Export

THE announcement made in an adjoining column concerning the export of goods made of raw materials which are in short supply may require a word of explanation to some readers, although to others its significance will be well understood. It is published at the request of the Minister of Information, and is intended to meet and assuage a certain volume of American criticism which, if ignored, might hamper the growing co-operation of the United States with this country in achieving our common aims. It has been alleged in America that in some cases raw materials supplied to this country under the Lease-Lend Act are being used by British manufacturers for the production not of munitions, but of goods for export, and that such exports are directly competing with corresponding goods exported by the United States. In support of this allegation, American manufacturers have pointed out that among the advertisements in this and other journals are some for products made from raw materials known to be in short supply and now being sent to us by the United States. It is not our desire to debate the merits of this American criticism or to discuss whether it is practicable to guarantee that no raw material received in this country from the United States under the Lease-Lend Act shall be used in the manufacture of goods for the export market. We publish the announcement in the sincere hope that it will fulfil its intended purpose of helping to remove a possible cause of friction and misunderstanding between two great Powers, on the cordial co-operation of which the freeing of the world from tyranny depends. The announcement as published herewith has been adapted to make it clear that it applies not only to goods mentioned in our advertisements, but also to products described in our editorial columns.

INDIAN ANTIMONY.—Following research, several sources of antimony ore have recently been found in India, and it is expected that refining plant to work the ores will shortly be installed.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE LOSS OF H.M.S. "HOOD"

SIR,—At Jutland three of our battle-cruisers were destroyed by the blowing up of their magazines. The German ships, on the other hand, suffered severe punishment without one such incident. The "Lützow," the only modern capital ship lost by the Germans in that battle, was so badly battered that they gave up all hope of getting her home, and accordingly sank her themselves by torpedo or gun fire.

The reason given for the disastrous British losses was the absence of efficient curtaining between ammunition hoists and magazines, with the result that a hit on a gun turret would be followed by a flash down the hoist and into the magazine.

This defect was remedied immediately afterwards in existing ships, and was, of course, not perpetuated in new construction.

When the "Hood" engaged the "Bismarck," however, she blew up within a few minutes of opening the action.

The "Bismarck" subsequently had some eight or nine torpedoes put into her; she was riddled with 16in., 14in., and 8in. shell and only after a further torpedo attack did this superbly constructed ship finally go to the bottom. Not one "lucky shot" caused her magazines to blow up.

It is obvious that the magazine explosions in British capital ships call for serious inquiry, and some other explanation than the Jutland one or the "lucky shot" theory of the popular Press.

I would like to suggest that the form in which ammunition is carried has some bearing on the question. It is well known that the German propellent charges for all guns are carried in brass cartridge cases, whereas on British ships the charges for the largest guns are carried in bags of silk or some such fabric.

Without a shell actually bursting in the magazine, it is quite conceivable that the protective armour deck over the magazine might become sufficiently damaged to allow a flash into the magazine from a shell burst in an adjacent space on board. In such a case the German charges would probably receive sufficient protection from their brass cases, whereas those in the British ships would be easily fired.

In support of this reasoning it might be pointed out that the smaller British guns, such as those mounted in our cruisers, are provided with propellent charges in brass cartridge cases, and these ships have not shown any tendency to suffer destruction by magazine explosion, even when subjected to very severe punishment in action. I. T. MATTON.

Hale, Cheshire, October 7th.

THE OERLIKON COMPANY AND GERMANY

SIR,—In the issue of *The Sphere* for September 6th there appeared an article entitled "The Beleaguered Country." The writer of it has collected a lot of information about Switzerland and its position since the outbreak of the war, particularly since the collapse of France, but many of the facts and figures have been misstated or wrongly interpreted. An endeavour to correct it in every particular would lead too far, and we propose therefore to deal exclusively with what directly interests us as the representatives of a Swiss electrical engineering and contracting concern.

Besides other things, the article states: ". . . . and the Oerlikon Corporation in Zurich are going full steam, but they are working exclusively for Germany. . . . The Oerlikon make arms, above all anti-tank and anti-aircraft guns—defensive weapons whose quality is said to be unsurpassed anywhere."

We are here only concerned with the "Oerlikon Corporation," in other words, the "Maschinenfabrik Oerlikon," registered also as "Ateliers de Construction Oerlikon." Oerlikon is a village—now a suburb of the city of Zurich—from which the Oerlikon Company derives its name. The company was founded in 1876 and in the early years largely manufactured machine tools, followed by electrical machinery and apparatus, quickly, however, giving the electrical lines more attention than that of manufacturing machine tools, so much so that the latter section separated from the electrical department. Competition, particularly German competition, in the manufacture and selling of machine tools induced our principals, the Ateliers de Construction Oerlikon, in 1905–6, to dispose of this section to a new concern, the "Schweizerische Werkzeug-maschinenfabrik Oerlikon," nowadays also known as the "S.A. de Machine Outils Oerlikon."

The fact that both concerns are situated in Oerlikon occasionally leads to confusion between the two. We affirm most categorically that the companies have absolutely nothing in common. The statement that the Oerlikon Company is working exclusively for Germany is quite incorrect. Never during its long history has the Oerlikon Company been able to export any of its products, namely, electrical machinery and apparatus, worth mentioning to Germany. The powerful tariff and the State-sheltered German electrical industry saw to this, and all your readers, in the least acquainted with international trading conditions, will readily appreciate this fact. The Ateliers de Construction Oerlikon does not make anti-tank and anti-aircraft guns as mentioned in the article.

OERLIKON LTD.,
General Manager and Chief Engineer,
London, October 9th. G. WUTHRICH.

BOOKS RECEIVED

The Science and Practice of Welding. By A. C. Davies. Cambridge: University Press. Price 10s. 6d.

The Mercantile Year Book, 1941. London: Lindley-Jones and Brother, Ltd., 52, Bishopsgate, E.C.2. Price 20s. net.

Practical Cost Accounts. By A. Miller. London: Gee and Co. (Publishers), Ltd., The City Library, Basinghall Street, E.C.2. Price 10s.

Directory of Paper Makers of Great Britain and Ireland, 1941. London: Marchant Singer and Co., 326, High Holborn, W.C.1. Price 6s.

Universal Directory of Railway Officials and Railway Year Book, 1941–2. London: The Directory Publishing Company, Ltd., 33, Tothill Street, Westminster, S.W.1. Price 20s.

Blueprint Reading Simplified. By A. C. Parkinson. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 6s.

Aircraft Inspection Methods. By N. C. Bartholomew. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 7s. 6d.

Mercury Arc Current Converters. By H. Rissik. Second edition. London: Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, W.C.2. Price 25s.

The Physical Examination of Metals. By B. Chalmers and A. G. Quarrell. Vol. 2. London: Edward Arnold and Co., 41 and 43, Maddox Street, W.1. Price 20s.

Roads and Road Construction Year Book and Directory, 1941–2. London: The Carriers Publishing Company, Ltd., 1, Bridge Place, Belgrave Road, S.W.1. Price 10s. 6d.

Elementary Structural Engineering. By L. C. Urquhart and C. E. O'Rourke. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 21s. net.

Drainage and Flood Control Engineering. By G. W. Pickels. Second edition. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, W.C.2. Price 28s. net.

Road Transport*

ON such an occasion as this, it is not desirable to attempt to review the development of road transport, but I think it might be well to indicate one or two facets of it which ought to be in our mind's eye as we look to the present and to the future. Public carriers of goods on the road, as we know them to-day, are the modern development of a very ancient industry. For the most part they comprise individually small operating units and these again are, speaking generally, a young growth, full of initiative and energy, but lacking perhaps some of that stability which the ballast of long years of experience imparts.

The older and larger units in all forms of transport—I hope one may suggest without offence—have, over a long period of years, progressed through several stages of evolution in their relationship to the community. In the first stage the dominant feature was the interest of the proprietors or owners. Then followed the realisation that the customer must remain a satisfied man if the undertaking was to continue to thrive. Next followed the recognition that there must be fair and intelligent treatment of the workpeople employed, that good health, contentment and lack of anxiety were not only right and proper, but also commercially sound, and that without these things no undertaking could achieve permanent results. Finally came the stage at which it was realised that a business had not merely an obligation to its proprietors, its customers and its workers, but also an obligation in a wider sense to the community as a whole.

For the old-established concern the transition through these stages of evolution has been a comparatively leisurely process, free from violent reaction and violent change. Profound changes have been there, most surely, but they have come about gradually and for the most part with a lack of shock or disturbance.

But consider the difference in the case of the average road carrier. Born of the last war, the majority of them were intensely independent and individualistic by nature, characteristics which have been responsible for the energy, the progressiveness and the resiliency which have been such marked features of this industry. Consider what it means when persons with those characteristics have had to traverse the sweeping developments in outlook to which I have just referred, with the entire process crowded into the space of a few short years. Small wonder that they are emerging just a little breathless and confused.

This "hustling" process in evolution could have been achieved only by a spate of legislation and regulations, and in fact we find to-day that the carrying on of business as a goods operator in road transport makes one subject to, I believe, a far greater number of legal regulations than exist in regard to any other form of industry. Not only the operation, but the very existence of a carrier's business is subject to a veritable network of legislation. Much of it relates to vehicles, their construction and their running, and while many of us may find room for improvement in this or that particular section, taken as a whole, I do not think we should deem the regulations on such matters undesirable. Their main fault is the fault likely to be found in all law governing activities in which progress has been rapid; it lies in the time lag common in all legislative matters and in the reluctance of an over-burdened legislative body to modify its rulings so as to keep step with development.

The spirit of the "Red Flag Act" lingered in matters of mechanical transport for years after it should have been exorcised as an anachronism. Perhaps I might express the thoughts of some of us if I say that the spirit of the solid tyre still seems to haunt some of our motor laws. A goodly portion of this trouble is due to the very bulk of legislation. There are those who criticise ruling by departmental regulation; but, while it may have some rather obvious drawbacks, it certainly affords a practicable means of coping with such a situation as I have depicted, and I think most of those involved would wish to give full credit to the hard workers who in recent years have done so much to consolidate the mass of regulations relating to road transport and its operation and to bring it into better accord with modern conditions.

* * * * *

There are, however, other laws affecting the road carrier in the carrying on of his business which are unique to his particular industry.

One section comprises the various Road and Rail Traffic Acts and has been discussed by this Institute on a number of occasions. To-day I shall confine myself to emphasising the part this particular legislation has played in the forced evolution of the public carrier and, in particular, the unsettling and retarding effect of the policy of objections to the grant or renewal of licences under the Acts. The battles in the Traffic Courts added fresh fuel to the fire of ten years' strained feelings between carriers and railway companies, and certainly could not be held to advance the hopes expressed by the Minister of Transport, who sponsored the 1933 Act in the House, that the problem of the most scientific allocation of traffic could best be left to the carrying industries themselves to solve "in the spirit of partners."

* * * * *

Happily, some measure of what the Act failed to achieve directly, in this spirit of partnership, has been brought about, largely, I think, through the patient efforts of those representing the various interests on the Transport Advisory Council. As the Council is a statutory body set up under the provisions of the 1933 Act, our legislators may perhaps claim a measure of credit after all.

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Another section of the legislation affecting the carrier has been the Road Haulage Wages Act, which governs in great detail the rates of pay and conditions of employment of all those directly connected with the operation of the public carriers' vehicles. The control is effected through the medium of a National Wages Board supported by Area Wages Boards, the members of all of them being nominated by the various interests concerned and appointed by the Minister of Labour. On the Central Board sits an independent chairman supported by two other independent members, and these three are appointed by the Minister of Labour entirely at his own discretion. In case of disagreement between the two sides of the Board, the independent members carry the deciding vote.

There are those of us, both amongst the employers and equally on the labour side, who deeply regretted that it had not proved possible to secure that degree of support for the findings of the National Joint Conciliation Board, the voluntary body which preceded the statutory Wages Boards, to enable such findings to become legally enforceable under the fair wages clause of the Road and Rail Traffic Act. Under the National Joint Conciliation Board, as under other voluntary boards of a similar type, findings were arrived at by negotiation between the two sides, whereas under the statutory board, with the ultimate deciding power vested in its independent members, the process tends to become one in which each side states a somewhat extreme case with an eye to the ultimate position under what amounts to compulsory arbitration. Thus we have a very different process to the voluntary negotiation and, for obvious reasons, a less attractive one in that it tends to keep the two sides apart rather than to draw them together for the solution of their common problems.

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To-day, the railways and shipping, as complete industries, are for the period of the war under the absolute control of the Minister as regards all their essential functions. Road transport and canals, from the nature of their make-up, cannot be treated on quite similar lines and the question of just what lines of control are desirable to promote the greatest efficiency in the national interest is one which is very much before the Minister at this moment

I am breaking confidence with no one if I venture my personal opinion. Road transport remains to-day essentially an industry of small operators, but it is efficient in its operation and it possesses an elasticity and a power of quick adjustment to circumstances which might be found wanting in many more highly organised industries. These are virtues of high value under modern war conditions.

* * * * *

Now the ever-intensifying demands of what is rightly described as total warfare impose increasing responsibilities upon our Government and it is understandable that, in spite of the so far successful working of the road carrying system, it may well be the view of those bearing this responsibility that transport may have to face even greater demands under even more difficult conditions in the future. Consequently they must be satisfied that the system of official control over the carrying industry while the war lasts is such as to ensure beyond any possibility of doubt an immediate and positive response to Government direction in the face of whatever emergency may arise. Such a system of control must have two aspects—the decision as to which goods must move and which be held back if need be, and the direction of available vehicles so as to ensure that they operate to the best purpose and with an absolute minimum of waste effort and disruption of the contribution they make to the day-to-day life of the nation.

To succeed in its objects, such a system of control must combine the authority which only a Government Department can possess, with the operating knowledge which comes only from long experience in the carrying industry.

* * * * *

In passing, you will have in mind that, earlier this year, it was announced that it was the intention of the Government to endeavour to "peg" the cost of living by various methods. One way referred to was through the cost of transport of foodstuffs and other essentials, by holding railway freight rates at their existing level; in other words, bearing in mind the Government's financial agreement with the railways, by subsidy.

As you will have gathered, the same course could not be followed in regard to road rates, and as yet we have no indication as to the intentions of the Government in this respect.

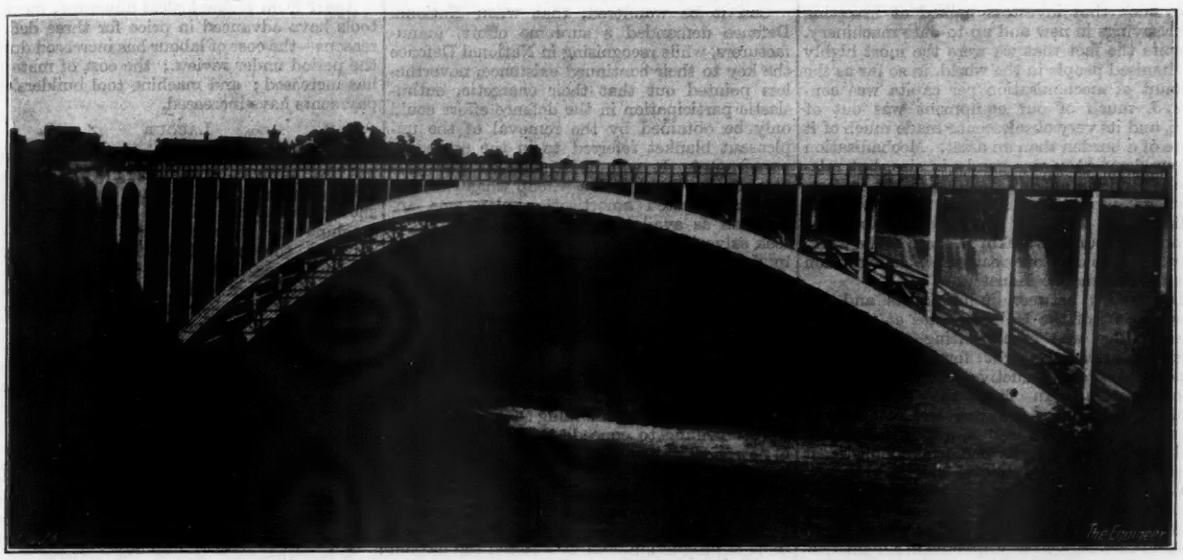
There must be present in the minds of all concerned a realisation that anything short of the closest partnership between the Government and the industry might easily produce a loss rather than a gain, in the working efficiency of operators whose resources and facilities are already stretched almost to breaking point in many directions; that there must be every effort to avoid any duplication of machinery as between the Government and the industry; to avoid pitfalls of robbing the industry of those essential to the good management of its operations by requisitioning their services for the Government side of the organisation and that every effort must be made to keep to the irreducible minimum disturbance of the normal methods of operation. The only justification for new departures must lie in the greater measure of security obtained and in the improved efficiency of working which may result.

* * * * *

War is a testing time for many things; if any proof were needed, it has proved once again and beyond all question of the vital part which road transport plays in the very existence of the nation in time of peril. Let us hope that this thought will tarry in the minds of our rulers in the future when this war is no more than a black memory of the past, and that in the years before us the road carrying industry will be accorded without question not only the responsibilities, but equally the privileges which, as a great national utility, it has earned.

* Presidential Address by J. S. Nicholl, C.B.E., to the Institute of Transport, October 13th, 1941. Excerpts.

RAINBOW BRIDGE OVER NIAGARA GORGE



Rainbow Bridge, Niagara Falls

THIS month there is scheduled to be completed in America the new steel and concrete arch bridge over the Niagara gorge which replaces the ill-fated "Falls View" bridge destroyed by an ice jam in 1938. The new structure has been named the Rainbow bridge, and a photograph of it is reproduced at the head of this page. The new bridge is situated about 1000ft. downstream from the American falls, and it crosses the gorge at a point where the depth of water, though not exactly known, is computed to be about 200ft. The flow of water here attains a speed of about 30 miles an hour. Since with such underwater conditions the erection of any kind of temporary supporting structure from the river bed was impossible, the bridge was erected by the tie-back method—the same method that was used for the great Sydney Harbour arch bridge in Australia.

Including four reinforced concrete arches on each side of the river, the bridge has a length of 1450ft., and the actual central steel arch is 950ft. long. The deck carries two 22ft. roadways, separated by a 4ft. centre mall. On that side of the bridge nearest the falls there is a pavement 10ft. wide, on which seats are to be provided for the comfort of those viewing the scene. There is no pavement on the other side.

The hingeless main arch consists of two steel box girders at 56ft. centres, cross braced by I beams. From the arch the deck is supported by hollow steel spandrel columns. For its erection there were built on top of the reinforced concrete abutments two temporary steel towers, 140ft. high. Wire ropes that were connected to each section of the arch as it was erected passed over these towers, were carried back some 200ft., and were connected to anchor blocks, each weighing 600 tons, embedded in the rock above the gorge. Travelling cranes worked out along each arch during erection towards the centre, placing the new steelwork as they progressed. Each arch springs from a point about 50ft. back from the edge of the river, and about 50ft. above its normal level. In this situation these foundations upon the rock are believed to be well beyond the reach of any flood water or ice-jam levels.

TIN TAILINGS TO BE SALVAGED.—Tin concentrates, now being produced at Kimberley, British Columbia, by the Consolidated Mining and Smelting Company of Canada, are being recovered in the form of cassiterite from "tailings" formerly regarded as waste.

To-day's Machine Tools, Machinery and Mechanised War*

By Lieut.-Com. R. E. W. HARRISON, U.S.N.R.

IT seems that we must learn our most vital lessons in the hardest way. That the greatest machine tool-producing country in the world should find itself confronted with a threat to its very existence and at the same time gradually wake up to the fact that it is short of the very items which made its previous prosperous existence possible, is one of those extraordinary things which bear out the truism that fact is stranger than fiction. That America, which has led the world for thirty years in the conception and quality of its machine tools, should enter a major war emergency deficient in these tools is a pathetic indictment of those whose leadership could and should have saved us from this condition.

In the first World War England, France, America, and Italy developed the technique which to-day we know as mechanisation of war, and poor though by comparison they were, the British tanks at Cambrai turned the tide—the German tanks were a failure. The vital significance of this, however, was that gone for ever was the old technique of war, which treated in terms of horse flesh, human sweat, and 30-calibre bullets; the age of mechanisation was on us, and armies measured their mechanical equipment in hundreds of thousands of tons of mechanisation instead of in so many head of cattle and so many effective bayonets.

In the hands of her land forces the effective use of the bayonet wrote the history of the British Empire for a hundred years. The retention of this tool to-day is little more effective than the officer's sabre, and even its most useful function as a toasting fork is disappearing with the provision of more adequately mechanised field kitchens.

MACHINERY AND TOOLS AS WEAPONS OF WAR

It is recalled that in 1917 a Colonel of U.S. Ordnance spent four months of his valuable time scouring the United States in an endeavour to procure a simple standard engine lathe, so scarce were these basic tools of mechanisation at that time.

When Germany's Nazi Party hatched its plans for European and subsequent world domination it was quick to put into effect policies embodying the lessons of World War No. 1. The first of these lessons was that mechanisation was here to stay and could only be provided by an absolutely adequate supply of machine tools. In 1934–35 the German Government offered a premium to all actual and potential munitions making factories by subsidising the acquisition of new, up-to-date, and highly productive tools and plant equipment. The plan permitted the manufacturer to amortise the tools in twelve months instead of the normal 240 months, and the policy was so effective that, whereas it was intended originally to put it into effect for one year, it was extended for a second year until the whole of the basic German industry in the mechanical field was carried on a solid unshakable foundation of most efficient machinery, tools, and practices. In this one policy alone Germany laid the fundamental basis for the blitz that she was preparing for the whole world.

How effective this planning has been the democracies know only too well. Their inadequate weapons, and their outworn tactics have had to be dropped or modernised under the unhappy conditions of actual active war, and the defence of security paid for in casualties and deepest misery. There are endless pictures, and stories without number, of groups of British and French troops who stood in the paths of the Panzer divisions opposing with their 30-calibre rifles and puny bayonets, modern tanks, so well equipped with armour that nothing less than a 75 mm. direct hit could make a dent in them. The crass stupidity of the military mind which permitted its people to go into battle with little more than their courage and a willingness to die forms a bitter and costly indictment of the experts who did not hammer home their story of what the Germans were doing, and the politicians who would not listen to them and profit by the reports of their accredited military and naval attachés.

By 1937 German factories for the production of tanks, machine guns, aeroplanes and cannon, as well as motor vehicles, combat cars, field kitchens, and aeroplane bombs, were equipped with modern machinery and tools which would permit them to turn out their products with a speed and precision heretofore completely unknown anywhere in this world.

What was happening to America and in a measure to England and France—the three great democracies—in the meantime? In England the industrial giant was just beginning to stir again from a sleep of industrial depression, reminiscent of "Rip Van Winkle." In France a more wearied people had turned to a form of state socialism which manifested itself in shorter hours, higher wages, unearned labour privileges, and costs which economic rehabilitation was totally unable to sustain. In America we were recovering from 1932, that dreadful

* American Society of Naval Engineers.

economic calamity which also was a legacy of the World War. Most of our machinery and equipment, *i.e.*, about 65 per cent. of it, was much over ten years old, and financial forecasts were such that investors balked at investing their savings in new and up-to-date machinery. Despite the fact that we were the most highly mechanised people in the world, in so far as the amount of mechanisation per capita was concerned, much of our equipment was out of date, and its very obsolescence made much of it more of a burden than an asset. Mechanisation in our democracy was gaudy in size, but relatively feeble in effectiveness, so feeble, in fact, that its productive efficiency had extreme difficulty in offsetting the cheaper labour of competing countries seeking a share of the world market. The only one really notable exception was the automobile industry.

Discussions between industrialists and the Government of the United States at the time when Hitler was rehabilitating the German basic industries brought forth nothing but opposition to any inductive plan of accelerated mechanisation. In fact, the N.R.A. was evolved to regulate industry and competition between these shabbily equipped industries, and N.R.A.'s net result being monopolistic, it eventually toppled of its own weight.

While Germany was re-equipping its industries, aided by accelerated depreciation allowed as deduction from income tax, the policy of our Federal Government was directed in a diametrically opposite channel. First, was N.R.A., which divided industry into groups and erected protective economic umbrellas over the least efficient in the groups. No more effective plan of perpetuating obsolescence could have been conceived than the price-fixing powers which were assigned to N.R.A. by Congress. N.R.A.'s defeat and elimination were largely brought about by competitive business interests believing in competitive economy and profit. None can forget the feeling of relief which was experienced when the Supreme Court delivered its verdict over the puny body of a very dead chicken.

As though this were not enough, Congress then proposed further retribution, along exactly opposite lines to those used by Germany, by its proposal to increase Federal revenues by voting a reduction in depreciation allowances for tax purposes.

As a result of discussions between the Treasury Department and Congress, the Treasury promised to reduce depreciation rates throughout industry, and to secure extra income without legislation. Concurrently, a minority of manufacturers in the United States who had carefully weighed the effects of the German armament acceleration, due to the depreciation plan, became vocal. Eventually, the discussion degenerated into a political free-for-all as those in Congress who favoured the setting of obsolescence or depreciation rates by fiat grabbed at the proposal for consideration of the German plan in the belief that it would bolster their case, *i.e.*, that depreciation could be made a matter of law, irrespective of what the facts of the case might happen to be. This, of course, was absolutely contrary to the previous United States conception of a democratic economy, and much time and thought were devoted by another little band of "rugged individualists," who fought tooth and nail with all concerned to maintain that industrial cannabalism is a necessary concomitant of free enterprise, and that the rate at which the industrial Moloch wore out its teeth was a matter of industrial progressiveness and efficiency, and that it was known and evaluated by these conditions only, law makers notwithstanding.

It is worthy of note at this time that income taxes started with World War No. 1. Prior to that time the practice had been to write off capital investments as rapidly as possible, which course placed the manufacturing companies in excellent position to take advantage of every item of modernisation offered for their production lines. Fundamentally, the policy of the Treasury Department in placing the onus of proof of depreciation on manufacturers, thereby catching about 95 per cent. of them unprepared with proof, placed a large, thick, damp, suffocating blanket upon the nice little flower of American industrial progressiveness, which hitherto had been the envy and admiration of the whole of the industrial world—with one exception, *i.e.*, Germany.

Can it be wondered, that when National Defence demanded a supreme effort, manufacturers, while recognising in National Defence the key to their continued existence, nevertheless pointed out that their energetic, enthusiastic participation in the defence effort could only be obtained by the removal of the unpleasant blanket referred to in the preceding paragraph? It will be recollected that this blanket was lifted with a whoop when the five-year accelerated amortisation plan was announced as available to all those who might seek salvation by a rush to get under the wire by dead-line date.

When a similar scheme for the modernising of American mechanical industry was discussed with manufacturers previously, it was rejected, because it was believed (we being at peace) that it contravened a basic principle of democracy, *i.e.*, it rewarded taxation and automatically inversely gave sanction to punitive taxation which was something the conservatives were unwilling to concede to the Government in power. The results of N.R.A., plus decreased depreciation allowances, plus the decision to permit *laissez faire* policy to govern the rehabilition of American industry, are well known. Industry took its own good time to sharpen its tools of production, and we entered the present conflict with a banked-up demand for machine tools which by comparison made the demands of the last war look like the business of a corner grocery store in a country town of 2000 people.

It was extremely significant that the first thing that the heavy goods manufacturers demanded in the present emergency was an accelerated amortisation plan. After much costly delay and debate, the mountain produced its mouse in the form of the five-year amortisation plan, with its accompanying tags of non-reimbursement certificates, &c., *ad infinitum*. Under the stress of imminent war, which could not be seen in 1934–35–36 and 1937, the men at the congressional helm offered that which they had previously condemned. The United States Government five-year accelerated depreciation plan was the result, after it became apparent that without it the protective effort of the nation would be fatally delayed.

Current Situation

It is expected that the machine tool industry will turn out tools to the total value of 750 million dollars this year of 1941, and this is a stupendous amount of money when one considers that the prior peak of 1929 was only 275 million dollars. However, this is not the whole story by any means, because the unit price of machine tools has about doubled in the interim, so that to equal the number of units produced in 1929 at present-day values would call for 550 million dollars. On the whole therefore it may be said that the present war effort of the United States machine tool industry is producing 50 per cent. more machine tool units than was the case in the previous peak of 1929. As the bank of unfilled orders has increased continuously for each of the last twelve months, it is obvious that the war effort of the United States machine tool industry, is not yet nearly adequate to accommodate the greatly increased demand for mechanical combatant equipment.

Concurrently, with any weighing of the debits and credits in the machine tool situation, sight must not be lost of the fact that there has been much technological progress in the effectiveness of all machine tools, and on the basis that a price must always be paid for improvement in performance, it is only fair to point out that the productive efficiency of practically all machine tools is about 20 per cent. greater than it was ten or twelve years ago.

Machinery has advanced in price partly because of this same better productive capacity of the tools of to-day, and if a definition of "better" is required, it can be said that the tools of to-day accomplish more of a process in less time, with less raw material, with less power per unit of work performed, than was formerly the case.

Economic Position

Apart from technological advances, machine tools have advanced in price for three definite reasons—the cost of labour has increased during the period under review; the cost of materials has increased; and machine tool builders' tax payments have increased.

Labour

Comparative freedom from labour difficulty has been enjoyed by the machine tool industry. Investigations of the Bureau of Labour Statistics show that 75 per cent. of all workers in the machine tool industry were working on one shift at the end of 1940. What actually happened was that a very large proportion of these men were working a considerable amount of overtime, and their total earnings were augmented proportionately. Current thought on the labour situation tends in some respects to be erroneous in concept; for instance, one authority indicates an exhaustion of available labour supplies in the near future. As this commentator has in mind skilled machine tool mechanics, his conclusion is wrong, because the available supply was exhausted a year ago, and the new men fed into the industry in the interim have been trained by the industry and the trade schools. Future reinforcements without doubt will have to come from these same two sources.

Sub-contracting is not the answer to the accelerated machine tool production problem, because to build good and accurate machine tools requires a degree of supervision and integrity of accuracy which the average sub-contractor cannot supply, for the very simple reason that he has never been trained to either see or produce this accuracy.

While greatly increased sub-contracting is undoubtedly the answer to many production problems, it can be eliminated definitely as a major factor in the machine tool industry, and the sooner this fact is recognised the better it will be for our all-around national security. An analysis of machine tool building costs will show that there is in normal times a very substantial amount of sub-contracting.

Conservation of Productive Time

Far-seeing machinery users have for years realised that lathes, milling machines, drilling machines, and planers use only about 26 per cent. of the total available time for actual cutting operations, and this characteristic indicates wherein lies the major field for speeding up production and effecting economies. Better tooling service, permitting more continuous cutting of metal to be maintained, is worthy of the closest study, and it should be set up as a national objective that all machine tools should be so employed that they are actually cutting metal at least 50 per cent. of the time they are in operation.

Management

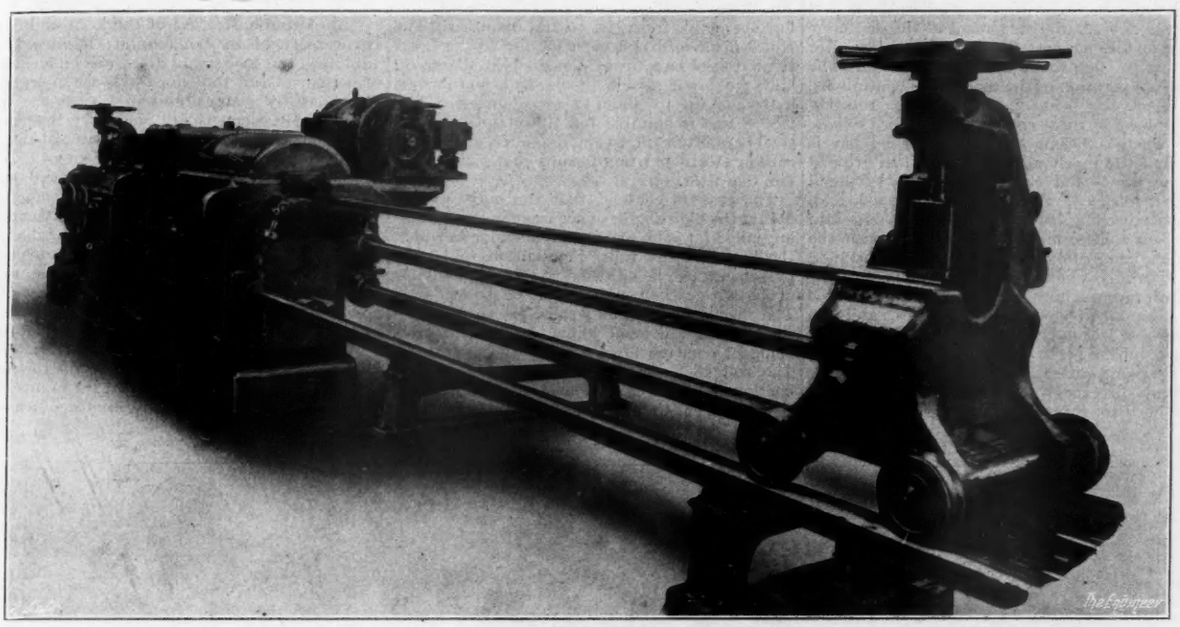
In all production problems the most important element making for success or lack of it is management. Fortunately, we have in the ranks of the American working people the most industrious, ingenious, and "highly appreciative of good-living people" in the world. Furthermore, these same people are the most responsive to good and progressive management. Hence, the thought is offered without any serious danger of refutation that such blow-holes as exist in our economic structure to-day are due more to the shortcomings of management which should have exercised the skill and farsightedness necessary to eliminate them. To blame our economic distress, our lack of ability to fill our machine tool orders, the delays in our rearmament programme, the shortages of anti-aircraft guns and ammunition, on the lack of an unlimited well of skilled labour in the machine tool field, is to take a stand which merits what is technically known as a good "horse laugh," providing, of course, one has the strength and sense of humour to extract a laugh out of a situation that tends to become too tragic to be funny.

Conclusion

No less an authority than T.N.E.C. has stated that "democracy will fail if we destroy

CENTRELESS BAR-TURNING MACHINE

SIR JAMES FARMER NORTON AND CO., LTD., SALFORD, ENGINEERS



profit economy," and no quarrel can be had with this basic thought. With increasing labour and material costs, selling prices must advance if we are to preserve this profit economy.

Furthermore, prices will naturally advance in reflection not only of increases in the costs of labour and material directly employed in the production of a given piece of machinery, but also in proportionate measure to increasing costs of supplies and the materials which service productive labour.

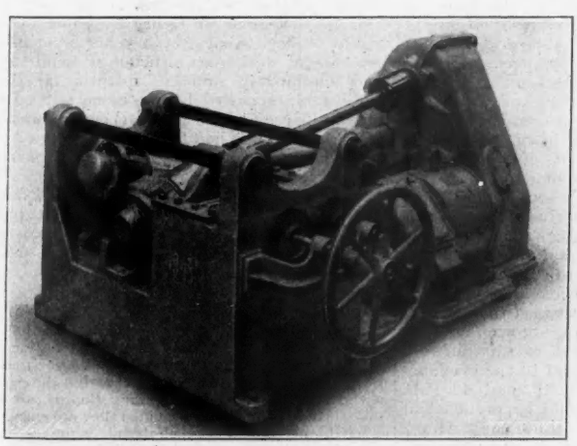
The ultimate in our thinking on this subject therefore gradually becomes obvious, *i.e.*, even in wartime, political, industrial, and social leadership should be devoted to the production of an increased quantity of better quality goods, whether these goods be swords or ploughshares. It is recognised that this objective can only be obtained by improved mechanical processes, which in themselves cost a progressively increasing amount of money, but which are more than offset by a lowering of ultimate costs and the spreading of the benefits of mechanisation to all the people; in the case of industrial goods—by a better standard of living; and in the case of war goods—by victory for our side, without which in complete form, nothing would have value.

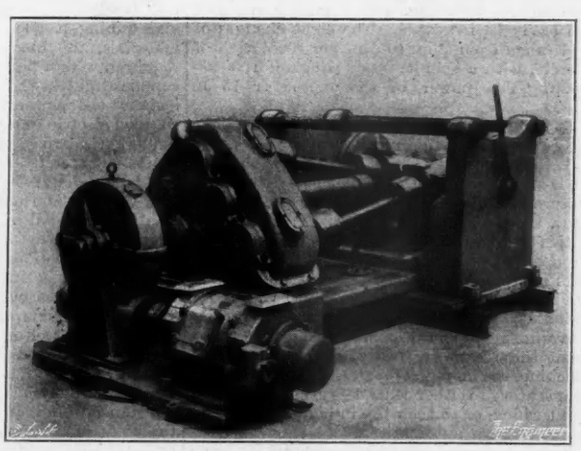
Centreless Bar-Turning and Straightening Machines

AN improved type of centreless bar-turning machine, illustrated herewith, has recently been developed by Sir James Farmer Norton and Co., Ltd., Adelphi Ironworks, Salford, 3. The machine is designed to turn down black rolled or forged round bars and billets at high speeds to very close limits of accuracy, and comprises a main headstock with runways and gripping carriages at each end of the headstock. The carriages are provided with an arrangement for clamping the bars during the turning operation, and run on rails which can be extended to suit the longest bars to be turned.

The whole of the driving and feed mechanism is contained in the central headstock, with the driving motor mounted on a bracket at the rear of the machine. This motor is provided with speed variation to cover the range of spindle speeds, and is fitted with solenoid braking. The drive is through multiple vee ropes and pulleys, followed by a single helical reduction gear drive direct on to the main hollow spindle. The entering end of the spindle carries the roughing cutter head, the other side driving through a spider to which is attached the finishing head. An adjustable roller steady is provided between the two cutter heads. Large openings are provided for access to the cutter heads, and steadies and easily operated roller covers protect the operator and prevent any swarf, &c., from being ejected from the front of the machine. Similarly, large openings at the rear permit the discharge of the swarf and coolant down inclined chutes into pits in the foundation at the rear of the machine. The feed drive is built as a unit, and is mounted on the front of the headstock casting. The eight changes of feed and feed reverse through a multi-plate clutch can be operated while the machine is running from levers at the front of the headstock.

Push buttons on the headstock control the spindle speed change, the revolutions of which can be directly read on a large dial tachometer built into the headstock cap. The feed saddles carrying the serrated feed rollers are spring





BAR-STRAIGHTENING MACHINES

lc.ded to allow for any variation in the diameter of the black bar and can be rapidly adjusted by means of large-diameter hand wheels. Adjustable spring-loaded roller supports carry the bar at the correct height while it is entering the feed rollers. A similar arrangement at the discharge end provides support for the finished bar after passing through the finishing cutter head. The cycle of operation of the machine is continuous, the black bar being fed through the rotating cutter head by means of the serrated feed rollers, and when sufficient length of finished bar is through the machine, this end is then gripped in the right-hand carriage and the left-hand gripper released. A fresh bar is gripped, and, as the preceding bar feeds through, passes into the feed rollers, and so proceeds to push the first bar completely through, this being repeated for consecutive bars without stopping.

Both the roughing and finishing cutter heads have hardened steel roller steadies, and are adjustable within their ranges. For black bars only requiring up to $\frac{1}{8}$in. reduction in diameter, no roughing cutter head is necessary, but for amounts in excess of $\frac{1}{8}$in. it is recommended that both roughing and finishing heads should be used. No burnishing attachment is required, as the bars as turned are equal in finish to bright drawn or ground bars. The finished bars are guaranteed concentric to within 0·0005in. on $1\frac{1}{4}$in. diameter bars and 0·001in. on 4in. diameter bars, and the variation in diameter on a 20ft. bar will, it is claimed, not exceed 0·002in.

The range of bars handled by the machine illustrated is from 1in. to 4in. finished diameter from 10ft. to 20ft. long, but the maximum length can easily be increased. The eight changes of feed range from $\frac{1}{32}$in. to $\frac{1}{4}$in. per revolution of spindle, with a spindle speed range of 100–400 r.p.m. The power of the motor is 15–60 H.P.

It is advisable that bars should be straight before being turned, and those which are badly rolled or "kinked" should be passed through a bar-straightening machine, such as that manufactured by Sir James Farmer Norton and Co., Ltd., and illustrated herewith. The machines of this type made by the firm have been designed to deal with high-carbon, heat-treated steel bars up to about 70 tons tensile strength, and having a relatively high yield point; that is, for materials which meet aircraft and various Government specifications. During heat treatment these bars are badly distorted, and the machines are intended for straightening the bars preparatory to either centreless grinding, centreless turning, or to their use in high-speed turret lathes and bar automatics.

The No. 1 machine has a capacity for heat-treated steel bars from $\frac{1}{8}$in. to $\frac{5}{16}$in. diameter, and up to 70 tons tensile strength. In addition, the machine will deal with bars of lower-carbon steels and non-ferrous metals in larger diameters, according to the nature of the material. The No. 2 size machine is designed for use on non-ferrous metals from $\frac{1}{4}$in. to 1in. diameter. The No. 3 machine has a capacity for 70-ton heat-treated steel bars, from $\frac{5}{16}$in. to $1\frac{1}{2}$in. diameter, and for lower-carbon steels and non-ferrous materials up to about $2\frac{1}{4}$in. diameter. The No. 4 size is suitable for 70-ton heat-treated steel bars, from $\frac{1}{2}$in. to 3in. diameter, and lower-carbon steels and non-ferrous materials up to 4in. diameter.

The makers contend that the only way to obtain the high degree of accuracy in straightening called for is by means of a machine in which the angle of the rolls, in addition to lateral movement, can be adjusted to suit the diameter of the stock as well as the nature of the material. The machines have two rolls, each driven by shafts with universal joints, one of the rolls being of concave form and the other parallel. The roll shafts are mounted in heavy roller bearings and cast steel housings. The angle of the rolls is set to give full-line contact with the stock, and the latter should be set into the concave roll, so that it is bent beyond the elastic limit of the material. In this way very accurate straightening, it is claimed, is obtained, and all end kinks, as well as middle bends, are removed without surface defects.

In addition to their use for straightening heat-treated steel bars, a number of machines have been supplied for dealing with bright-drawn bars, for extruded non-ferrous materials, and heat-treated aluminium alloys. To assist in maintaining a good surface finish on bright materials, the machines can be fitted, when required, with a pump feed arrangement which supplies fluid to the face of the rolls. In each instance the main drive is by means of a direct-coupled electric motor through totally enclosed reduction gearing, running in oil to the roll shafts. Lateral adjustment of the rolls is effected by hand through spur or worm reduction gears. The bars to be straightened pass in at the roll end of the machine and are conveyed through a tubular guide which projects from the reduction gear case, and thence out through the case itself on to suitable supports or a table for testing the degree of straightness. The bottom guide plates between the rolls are of hardened steel or phosphor bronze, and can be easily adjusted in height to suit different diameters. The motors fitted to the machines are respectively of $7\frac{1}{2}$, 15, 40, and 60 H.P. Substantial equipment should be provided at the point of entry to take care of the "whip" in bent bars, and to guide the bars through the rolls.

MAIN HEADSTOCK OF CENTRELESS BAR-TURNING MACHINE

Sixty Years Ago

BESSEMER, SIEMENS, AND THE WAR OFFICE

THE Autumn Meeting of the Iron and Steel Institute, held in London on October 11th, 1881, and the succeeding days, was enlivened—or perhaps distracted—for the space of an hour and a half by charges brought against the War Office by Dr. Siemens and Sir Henry Bessemer. Dr. Siemens accused the Department of taking his inventions without acknowledgment. In a paper on "Modern British Ordnance," submitted to the meeting, Colonel Maitland, of Woolwich Arsenal, had stated that a Siemens regenerative gas furnace had been installed at the Royal Gun Factory about seventeen or eighteen years previously. It had, he said, been found expensive as regarded both prime cost and repairs, and difficult to adapt to cover varying conditions. Dr. Siemens protested that the furnace referred to by Colonel Maitland had been built not to his designs, but to those of one of his ex-draughtsmen. Its failure, he said, had injured the reputation of his furnaces to such an extent that he had lost a sum of £30,000. Sir Henry Bessemer's complaint centred round his failure twenty-seven years previously to induce the War Office to accept steel as a material for gun-making. Sir Henry also—with a freedom characteristic of those days—accused Sir William Armstrong, of pronouncing from unworthy motives his steel as being unfit for guns. Colonel Maitland, in a few well-chosen words, which elicited much applause, disposed of these accusations. Everybody, he said, did not share Sir Henry Bessemer's confidence in steel twenty-seven years previously. The price of steel, even although it could have been obtained in sufficient quantity at that date would, he asserted, have alone sufficed to prohibit its use for guns until a cheaper material had been tried and had failed. Commenting on the incident in a leading article, we remarked that Sir Henry had enjoyed such a measure of success and had attained to such colossal fame and fortune that he had not even a poor inventor's excuse for raking up accusations based on transactions which took place more than a quarter of a century previously.

TECHNICIANS FOR THE FORCES.—Young engineers who were under twenty-five when registered for military service, and who came within the scope of the University Joint Recruiting Boards, are to have their cases reviewed provided they are engaged as civil, mechanical and electrical engineers and engaged in civilian work and qualified for appointment as technical officers in the Forces.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quantities are f.o.b. steamer

Exports to the United States

The Secretary of the Department of Overseas Trade recently explained the position as regards exports to the United States. "In order," he said, "to import the great volume of munitions and other vitally important goods which we wished to obtain from the U.S.A., the United Kingdom was obliged, so long as the rule of cash and carry prevailed, to force out to the U.S.A. the maximum volume of exports. This was one of the purposes of the so-called 'export drive' of the early months of 1940; and when the collapse of France made necessary concentration upon the production of war materials and exports had to be more carefully husbanded the U.S.A. remained the most favoured market. We were prepared, if necessary, to restrict supplies to the civil population in order to do so; and United Kingdom exporters were assured that their work was second only in importance to the actual production of munitions. Our exports to the U.S.A. in the first half of 1940 were considerably greater in value than in the same period of 1939, and were maintained above the 1939 level during the first half of 1941. By the passing of the Lease-Lend Act in March, 1941, the situation was profoundly changed. Not only was the strain upon our dollar resources immensely relieved, but as the volume of military supplies put in process of manufacture for us mounted, the United States administration, already occupied with its own defence programme, found it necessary to place restrictions upon the civilian use of some of the more scarce materials, and it became at once an obligation upon H.M. Government to see that the American manufacturer or exporter, who was stinted or deprived of his raw materials in order that such materials might be sent to us, should not find United Kingdom exporters offering manufactures of these materials to his own customers. H.M. Government therefore undertook to see that the materials obtained under the Lease-Lend Act, which are required for the prosecution of the war effort, should not in any case be diverted to the furtherance of private interests. This radical change of policy has inevitably caused many difficulties, and has led to a good deal of misunderstanding. The United States manufacturer or exporter has not always realised that the delivery of goods which have arrived in the United States or Latin American markets in the days of lease-lend was planned in the days of cash and carry; and since the machinery of trade cannot be changed overnight, he has found advertisements, still appearing, of goods which he thinks the United Kingdom exporter should not, and which in fact the United Kingdom exporter could not, now deliver, while, on the other hand, it has been baffling to United Kingdom exporters to find that some of their long-prepared plans to earn much-needed dollars must now be dropped. But the national gain is immeasurable. We are now in a position to obtain many essential imports without the necessity of finding dollars for them, and in this way we are enabled to save some of the energies which had formerly to be devoted to the export trade and turn them to more direct war purposes. But this does not mean that a high level of export trade to the U.S.A. is either unnecessary or impossible. Our dollar needs are larger than any volume of visible export trade which we can hope to maintain will wholly provide. We are still importing many things from the U.S.A. outside lease-lend arrangements. In return for this we can send to the U.S.A. a large range of manufactured goods made from materials which can be spared by the munitions industries, and, by the same token, not constituting an offer to the American consumer of something which his own producers are precluded from providing him with. The main traditional United Kingdom exports to the U.S.A. are, of course, whisky, raw wool, woollen goods, linen, some specialities in cotton, apparel and tin. Other traditional exports, of importance in the aggregate, are some coal and non-metalliferous products, earthenware, and some kinds of glass, certain specialities in machinery, leather and skins."

The Pig Iron Market

The steadiness which has characterised the pig iron market for several weeks appears likely to continue. There is no anticipation that there will be any price changes this year, and whilst the demand remains strong, it is not above the capacity of the producers to deal with, except in the case of hematite and, to a much lesser degree, of low-phosphoric foundry iron. Conditions may vary in different parts of the country, but in general the position is that the producing plants are operating at capacity and the country's whole production of pig iron passes rapidly into consumption. The accumulation of stocks which was encouraged by the Control during the summer appears to have ceased, but most consumers are now in the position of holding reserves which should carry them through any temporary emergency in the winter. The demand for low-phosphoric iron is active, since it is used for many purposes for which it was not formerly regarded as suitable. The hematite position also is tight, but the Control has the position in hand and by careful distribution and by encouraging consumers to use alternative mixtures wherever possible the supply is sufficient to go round and meet all urgent demands for war purposes. The high-phosphoric pig iron position is easy, since the chief users, the light castings foundries, are still working at well below capacity and it has not been found possible to employ much of this plant on work of national importance. There is a moderate demand for this description of pig iron, but there is no pressure upon the supplying works. Midland producers supply this in considerable volume to the North-East Coast and to Scotland, and no complaints are heard of delays in deliveries. In fact, so many consumers have built up reserves that a short delay in transport is not now so serious a matter as it was in the earlier days of the war. The ore position generally is satisfactory. Larger supplies of high-grade imported ore could be used, but for shipping and other reasons ore importations have been drastically cut down.

The Midlands and South Wales

The Midland steel works continue to meet an insistent demand, but, despite consumers' heavy requirements, deliveries are maintained at a satisfactory rate. Adequate supplies of billets and sheet bars to the re-rolling works have enabled the industry to operate at a high rate for some months. It is now experiencing an easing in the demand for small bars and in some cases the works could do with more orders. A slight change for the better is said to be noticeable in the plate position, although this is merely relative. All the mills have full order books, but in some cases are able to promise earlier delivery than was the case a few weeks ago. The greater part of the production passes to the shipyards, but boiler, locomotive and tank makers are taking up considerable tonnages. The activity at the munitions and armament works is reflected in an increasing demand for special and alloy steels and although the production of these descriptions has been extended the producing works are pressed to keep pace with consumers' needs. It is understood that Russian requirements are likely to increase the pressure upon this branch of the steel industry. The expected improvement in the demand for sheets has not materialised, but large tonnages are still being produced and the works have a long way to go before they will have completed the orders already booked. On the other hand, the volume of fresh business continues to be disappointing and is less than the contracts which are worked off. Busy conditions prevail in the iron and steel industry in South Wales and most of the works are fully employed on Government orders. It is reported, however, that some establishments have been able to turn their attention lately to work of a more commercial character, although this has happened in only a few cases. There has been no relaxation in the demand for heavy finished steel, except the decline which has been noticeable for the past month or two in heavy joists and sections.

Scotland and the North

Pressure on the Scottish steel works continues unabated in nearly all departments. Orders on Government account are reaching the works in a steady flow and most of those in hand are of a priority character. Some works report a revival of the demand for structural steel, but this is not a common experience; in fact, some firms could do with more work of this character. Constructional engineering firms in Scotland, however, in the majority of cases are only moderately busy, although there is a certain amount of irregularity in the way in which new business is spread over the industry. The lighter sizes of joists and sections are more in demand than the heavier, but there are signs that the slackness which has been noticeable in the case of heavy joists and sections may spread to the lighter sizes, which have hitherto been in good demand. There is a steady call, also, for bars and of late the larger diameters have come in for most attention, whilst there has been a decline in the request for the smaller sizes. This movement has principally affected the re-rolling works, some of whom are in a position to give fairly near delivery. The raw material position is satisfactory, and although heavy quantities of billets and sheet bars are being absorbed, most consumers have substantial stocks in hand. There is an active business passing in the thinner gauges of sheets, but a decline is noticeable in the demand for the heavier sizes and most of the sheet works are in a position to give fairly early delivery of the latter description. The plate position has not changed. There is an insistent demand and large tonnages continue to pass to the shipyards, whilst good outlets are provided by the locomotive builders and tank makers. Great activity continues to rule in the steel consuming sections of the Lancashire industry. The demand is particularly strong for plates, whilst, on the other hand, the quietness at the Lancashire constructional engineering industry is reflected in a comparatively poor demand for heavy joists and sections. There is a steady call for bars 3in. and over and delivery times for this material have been extended. Colliery material is in urgent demand and big tonnages of arches, roofing bars, &c., are passing into consumption.

Copper and Tin

The copper situation has not greatly changed so far as can be seen, and what effect the sending of supplies to Russia will have upon the position in Great Britain has yet to be seen. Speeches by public men indicate that certain quantities have already been sent to the Soviet, probably direct from Empire sources of production, and the United States probably is also supplying Russia with copper, amongst other things. The situation in this country may be regarded as comfortable, although there is little surplus for other than war purposes. It is understood that supplies are reaching this country regularly and that no firm engaged upon national work has had to go short of metal. A certain amount is also distributed to firms making exportable products which are urgently required in certain countries. For instance, a little business has been done with Turkey under the agreement existing between Great Britain and that country. In the United States the position remains tight and the use of copper for other purposes than the defence programme has been drastically curtailed by the authorities. The fears expressed in some quarters in the United States that later on a shortage may develop are believed in this country to be exaggerated as very considerable quantities are available from South American producers. . . . The chief item of interest in the tin market of late has been the official intimation that export licences for tin are not likely to be issued for some time. This resulted in rather free selling of cash tin. It is understood that the Ministry of Supply bought spot tin at £256 and this did much to prevent a downward movement of the price. A rise in the price of three months tin was checked by smelters offering the metal at £260. The contango, which is affected by these two influences, has varied between 70s. and 80s. At the moment the stock position appears to be good.

Lead and Spelter

There have been no developments of importance in the British lead position and supplies of the metal reaching this country appear adequate. A certain amount of metal is available for non-essential purposes, although the surplus after the war industries, which are heavy consumers, have been satisfied is not large. In the United States the position is somewhat stringent. According to statistics issued by the United States Bureau of Mines, the domestic mine production for the first six months of the current year was 228,478 short tons, whilst for the first seven months in this year the American smelters had an intake of recoverable lead in ore and scrap of 327,470 tons, compared with 343,150 tons in the corresponding period of last year. There is a large consumption of the metal in the United States for the defence programme and the metal is probably in somewhat shorter supply than spelter. . . . The spelter position in Great Britain, although rather tight, is not sufficiently so to check full supplies reaching the firms engaged in the war effort. In fact, there does not seem to have been any change in the position which has existed for some weeks. In the United States the principal development of interest has been an increase of 1c. in the domestic price of spelter from 7·25c. to 8·25c. This movement has been sanctioned by the American authorities with the idea of encouraging production, and whilst it might not have much influence upon the mine output indirectly, it may help production by bringing forward a certain amount of scrap metal for conversion.

Notes and Memoranda

Rail and Road

Standardisation in Germany.—Recent extensions of standardised production in Germany cover steam and diesel locomotives. In future it will be permissible for certain types of locomotives to be built only on approved standard lines.

Highway Engineering in South Africa.—The Concrete Association of South Africa has initiated a scholarship for research in highway engineering at the University of the Witwatersrand. The scholarship, which has an annual value of £250, is tenable for two years, subject to satisfactory progress.

The Reichsbahn Orders Bigger Wagons.—In order to deal with this year's cereal traffic the German Reichsbahn has placed in service in recent months a number of high-capacity wagons, loading 40 to 50 tonnes. The tracks of a considerable number of sidings, both of the Reichsbahn and privately owned, have been strengthened, and appliances for loading and discharge have been installed.

Hungary May Electrify.—In order to save coal and utilise existing power facilities, Hungary may shortly electrify certain local railways radiating from Budapest up to 100 route miles. Completion of conversion by the end of 1943 is part of the plan. Orders for fast motor coaches have been placed with Ganz and the Hungarian Siemens-Schückertwerke. A new type of electric locomotive is proposed.

Germany's Control of Norway's Railways.—Under German pressure the Norwegian State Railways have ordered several hundreds of additional goods wagons and steam locomotives, and a substantial number of German goods locomotives is said to have been lent to the Norwegian State Railways. Certain of the 3ft. 6in. gauge Norwegian lines have been converted to the standard gauge of 4ft. 8½in. under German auspices.

C.N.R. Earnings.—The Canadian National Railways earned during August last 25,808,928 dollars, an increase of 4,588,740 dollars, and operating expenses were 20,637,196 dollars, an advance of 3,085,189 dollars, leaving net earnings 1,503,551 dollars higher, at 5,171,732 dollars. Aggregate gross earnings for the eight months from January 1st are 193,179,858 dollars, an increase of 35,883,087 dollars, and the net earnings of 42,196,254 dollars show an improvement of 18,155,405 dollars.

Railway in Iran.—Recognising the importance of railway communications in Persia, the Government has appointed Brigadier-General Sir Godfrey Rhodes, general manager, Kenya and Uganda Railways and Harbours, as Director of Transport in Persia. General Rhodes, who was born in Canada, saw service in France and Salonica in the last war, and has been handling railway and harbour problems arising from the transport of large numbers of troops and quantities of materials in connection with the recent East African campaign. He has been general manager in Kenya and Uganda since 1929.

Air and Water

Karachi Needs More Water.—A project is under consideration by the Indian Government for the purpose of supplying water from the Indus to Karachi, as a permanent solution of the water shortage which is frequently experienced in Karachi. It is estimated that the scheme would cost about Rs. 170,000,000 and provides for a supply of ten million gallons per day. It is claimed that if the scheme could be undertaken at an early date it could be completed by 1946.

Wright Expansion at Paterson.—By installing specially designed multiple-tooled machinery the Wright Aeronautical Corporation has found it possible to increase output at Paterson, New Jersey, almost six times while floor space has been expanded only about three and a half times and man power has been tripled. The working force in the Paterson area has been enlarged from 5175 persons in 1939 to more than 17,000 at present. Some 2000 machine tools of practically all classifications have been purchased and installed in the various manufacturing areas in the Paterson plants during the past two years.

Table Bay Harbour.—The original 3½ years' contract for the new £4,000,000 harbour at Table Bay has now expired, and the third and last of the deep-water berths has been put into use. The occasion has prompted a review of the work by the *South African Engineer*, and an estimate of what has yet to be done. This will entail an extra 2,000,000 cubic yards of reclamation work in order to reclaim the 363 acres provided for in the contract, and there is also the extension of the original quay wall to provide four deep-water berths instead of the three at first decided upon. This work should be completed early in 1942. In conjunction with the harbour engineer, the Table Bay Advisory Board is now going into the question of the size and type of graving dock the Administration will be asked to build. The engineering problems to be overcome will also be considered.

Transport by Canal.—The Minister of War Transport has set up a Central Canal Committee, under the chairmanship of Colonel J. J. Llewellin, the Parliamentary Secretary, to advise him on questions of policy affecting inland waterways and to co-ordinate the work of six Regional Canal Committees. Acting on recommendations tendered by Mr. Frank Pick the six existing Regional Canal Committees have been reconstituted and their main functions will be to organise effective operation of the canals and the full and efficient working of craft and to survey traffic possibilities so as to make sure that traffic conveniently waterborne is allocated as far as practicable to the canals.

Miscellanea

The Institution of Production Engineers.—The Institution of Production Engineers has held its annual wartime luncheon at Grosvenor House, Park Lane. Proposing "The Institution," Sir Charles Craven reminded his hearers that it is now twenty years old and he urged it to keep its youth. The membership is now near the 3000 mark.

Sawdust in Bulk.—Mount Osborne is a sawdust pile, claimed by its creator to be the biggest and highest accumulation of its kind. It is named after Mr. C. P. Osborne, general superintendent of the steam plant of Portland General Electric Company. The sawdust was stored to stave off power shortage in the area due to drought conditions. The pile is 130ft. high and contains 10,450,000 cubic feet of sawdust, all collected from local sawmills.

U.S.A. Steel Statistics.—Figures issued by the American Institute of Steel Construction show that structural steel orders booked in the first half of this year were more than double those of the same period in 1940. The first six months' orders in 1941 totalled 1,298,432 tons, compared with 619,231 tons in the first half of 1940. Shipments for the first six months of this year totalled 1,055,946 tons, compared with 655,012 tons in the first half of 1940.

Spun Bleaching Kier.—The Indian Hume Pipe Company, Ltd., has adapted its process to the production of spun concrete kiers for cotton mills. A popular size is 6ft. diameter by 8ft. high. It is a vessel of special design, in which saponification of the fats and hydrolysis of the protein and other impurities of the cotton goods are carried out by boiling in the presence of alkalis. There are two types open and closed for non-pressure and pressure work.

International Labour Organisation.—A Conference convened by the International Labour Office is to be held at Columbia University in New York, beginning on Monday, October 27th. The principal subjects before the Conference will be the report of the Acting Director, Mr. E. J. Phelan, who has been in charge of the Office since the appointment of the former Director, Mr. John G. Winant, as United States Ambassador in London, and Methods of Collaboration between Governments' and Employers' and Workers' Organisations.

Directorate of Gas Supply.—An Order in Council was signed on September 11th transferring to the Board of Trade the functions in relation to electricity previously exercised by the Minister of War Transport. At the same time the Board has had under review the reorganisation required for the exercise of its functions in relation to the gas industry. It has been decided to set up a new division in the Industries and Manufactures Department (to be known as I. & M., Div. III) to carry out the Board's functions in relation to both industries. Sir Arthur Eborall will be Principal Assistant Secretary of the Division, and Mr. A. J. Cousin, Assistant Secretary. There is also to be a Directorate of Gas Supply to deal with questions relative to the public supply of gas to nationally essential factories, and to advise on the steps to be taken to secure the progressive development of the industry as a public service. Dr. E. W. Smith is to be Director-General of Gas Supply, and he will have the assistance of Mr. J. F. Ronca, Mr. G. Evetts, and Mr. P. Chantler.

Personal and Business

Mr. W. Allcock has been appointed chief engineer to Erskine, Heap and Co., Ltd.

Mr. William Shearer has been appointed chairman of Balfour Beatty and Co., Ltd., in succession to the late Mr. George Balfour.

The Great Western Railway Company announces that Mr. E. C. Cookson has been appointed assistant to the chief engineer, Paddington. Mr. T. T. Mead has succeeded Mr. Cookson as divisional engineer, Newport.

Mr. E. S. Cox, personal and technical assistant to chief mechanical engineer, L.M.S.R., Derby, has been appointed chief technical assistant to the chief mechanical engineer, Derby; and Mr. G. F. Kent, assistant to the district engineer, Inverness, has been appointed assistant to the district engineer, St. Pancras.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that in order to make sure of its insertion the necessary information should reach this office on or before the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Fuel Luncheon Club

Wednesday, Oct. 22nd.—Connaught Rooms, Great Queen Street, W.C.2. Luncheon, 12.40 for 1.10 p.m. Presidential Address, "Fuel and the Future," Sir D. Milne-Watson.

Institute of Metals

Saturday, Oct. 18th.—Birmingham Local Section: James Watt Memorial Institute, Great Charles Street, Birmingham. "The Welding of Light Alloys," E. G. West. (Afternoon.)

Wednesday, Oct. 29th.—Engineers' Club, Albert Square, Manchester. "Causes of Porosity in Tin-Bronze Castings," T. F. Pearson and W. A. Baker. 4.30 p.m.

Institute of Transport

Saturday, Oct. 25th.—Metropolitan Graduates. Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. Address by the President, J. S. Nicholl. 2.15 p.m.

Institution of Chemical Engineers

Friday, Oct. 24th.—Institution of Civil Engineers, Great George Street, S.W.1. "Scientific Knowledge and Action," Sir Richard Gregory. 2.30 p.m.

Institution of Electrical Engineers

Saturday, Oct. 18th.—N. Midland Centre. Hotel Metropole, King Street, Leeds. Chairman's Address, F. Gurney. 2.30 p.m.

Thursday, Oct. 23rd.—Savoy Place, Victoria Embankment, W.C.2. Presidential address, Sir Noel Ashbridge. 4 p.m.

Saturday, Oct. 25th.—S. Midland Centre. Grand Hotel, Birmingham. Wartime Luncheon. Chairman's Address, R. H. Rawll. 12.30 for 1 p.m.

Monday, Oct. 27th.—N.E. Centre: Neville Hall, Westgate Road, Newcastle-on-Tyne. "Outdoor Bushings—their Construction, Testing and Standardisation," W. A. Cook. 6.15 p.m.

Institution of Mechanical Engineers

Friday, Oct. 24th.—Storey's Gate, Westminster, S.W.1. Presidential Address, "The Position of the Locomotive in Mechanical Engineering." W. A. Stanier. 2.30 p.m.

Institution of Structural Engineers

Saturday, Oct. 18th.—Yorks Branch: Hotel Metropole, Leeds. Chairman's address, H. A. Whitaker. 2.30 p.m.

Junior Institution of Engineers

Saturday, Oct. 18th.—39, Victoria Street, S.W.1. "Fire Fighting and the Engineer," J. W. Stenson. 2.30 p.m.

Manchester Association of Engineers

Saturday, Oct. 25th.—Engineers' Club, Albert Square, Manchester. "Economic Planning of a Modern Store," J. S. Beaumont. 2.30 p.m.

Saturday, Nov. 1st.—Reynolds Hall, College of Technology, Manchester. "The Water Grid," A. E. L. Chorlton. 2.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Oct. 17th.—Literary and Philosophical Society, Newcastle-upon-Tyne. Presidential address, W. A. Woodeson. 6 p.m.

Thursday, Oct. 23rd.—Student Section. Bolbec Hall, Newcastle-upon-Tyne. "Some Aspects of Cylinder Head and Combustion Chamber Design for Internal Combustion and Compression Ignition Engines," G. Wright. 6.45 p.m.

Friday, Oct. 31st.—Mining Institute, Newcastle-upon-Tyne. "Merchant Sea Power, 1919–1939," Sir Westcott S. Abell. 6 p.m.

Sheffield Metallurgical Association

Tuesday, Oct. 21st.—198, West Street, Sheffield. "Any Questions?" 6.30 p.m.